ENGINEERING

An Illustrated Weekly Journal

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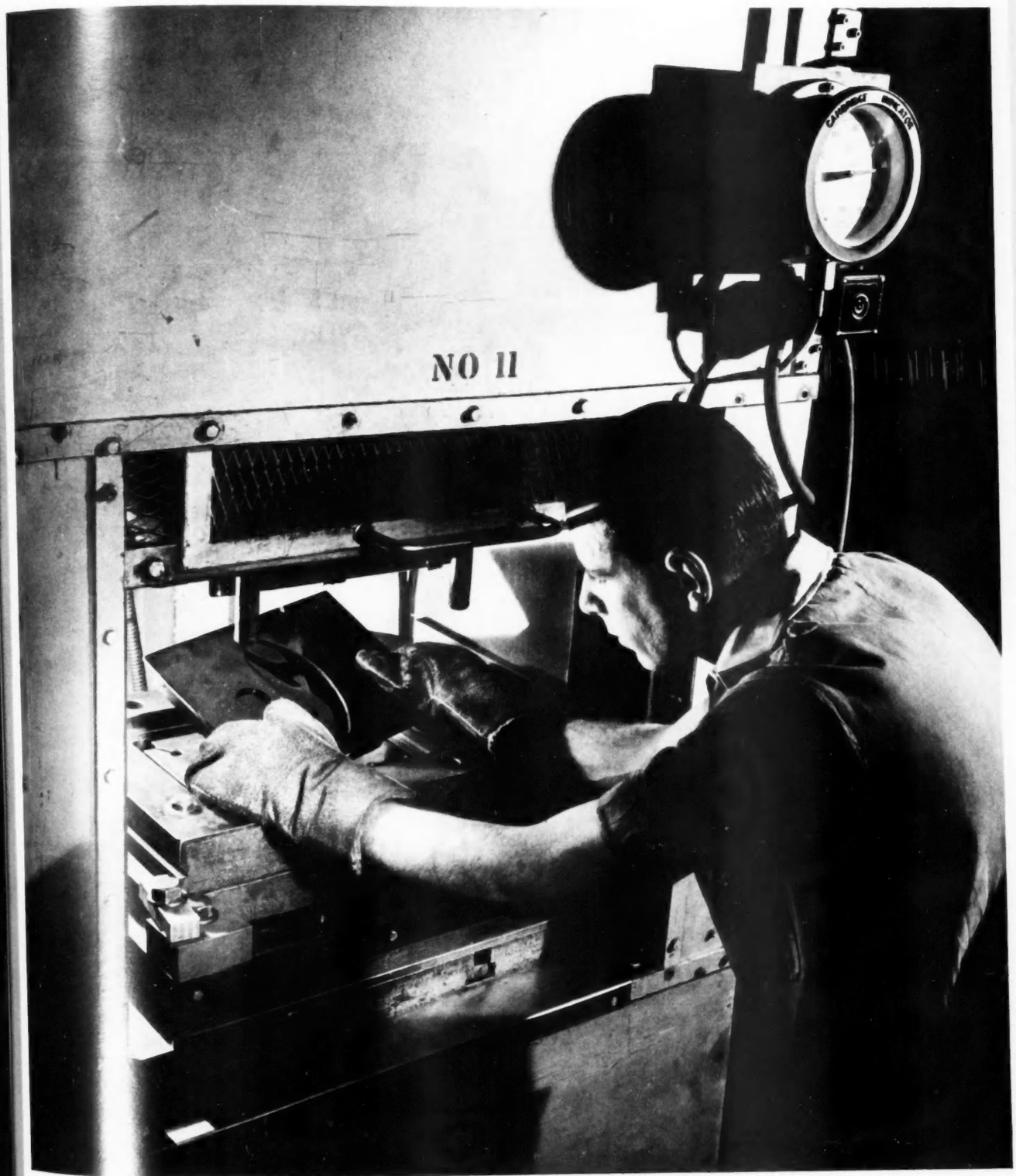
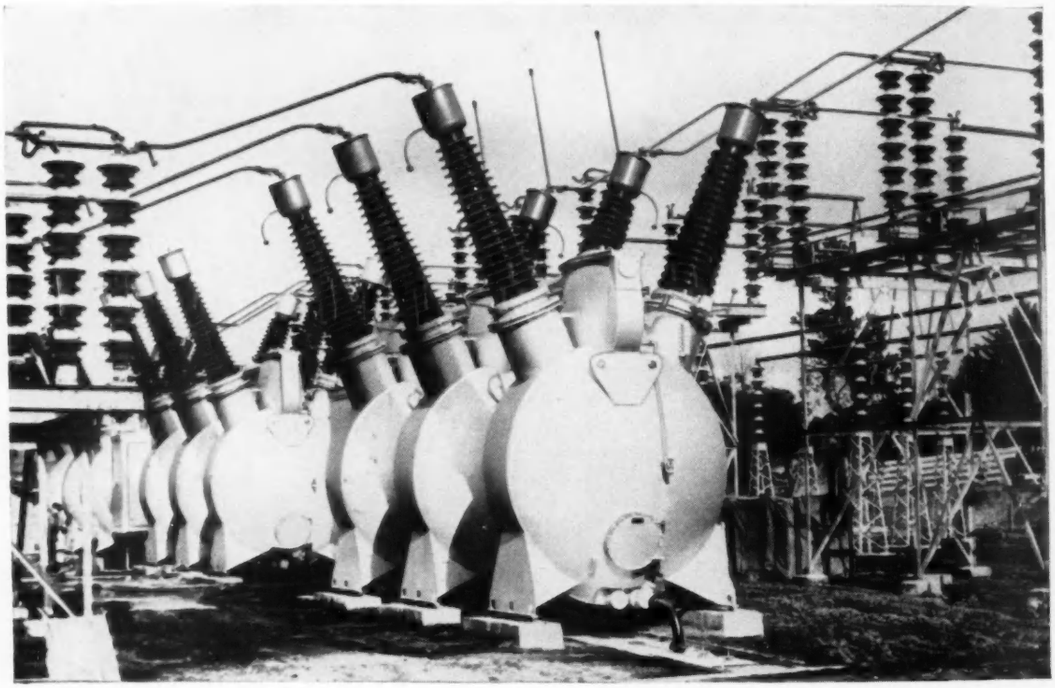
Vol. 181 No. 4710 *LONDON, FRIDAY, JUNE* 15, 1956 PRICE 2s.



MOU G IN PHENOLIC RESIN

220-kV CIRCUIT-BREAKERS

for the State Electricity Commission Victoria



Sixteen 220-kV, 5,000-MVA Shuntarc oil circuit-breakers have been ordered by the State Electricity Commission, Victoria, Australia. The illustration shows the installation at Yallourn power station where six of the circuit-breakers are already in commission.

Super-tension BTH 'Shuntarc' circuit-breakers are in service in many parts of the world; a recent order from the British Columbia Electric Company covers six 230-kV, 7,500-MVA units.

BRITISH THOMSON-HOUSTON

THE BRITISH THOMSON-HOUSTON COMPANY LIMITED · RUGBY · ENGLAND

Member of the AEI group of companies

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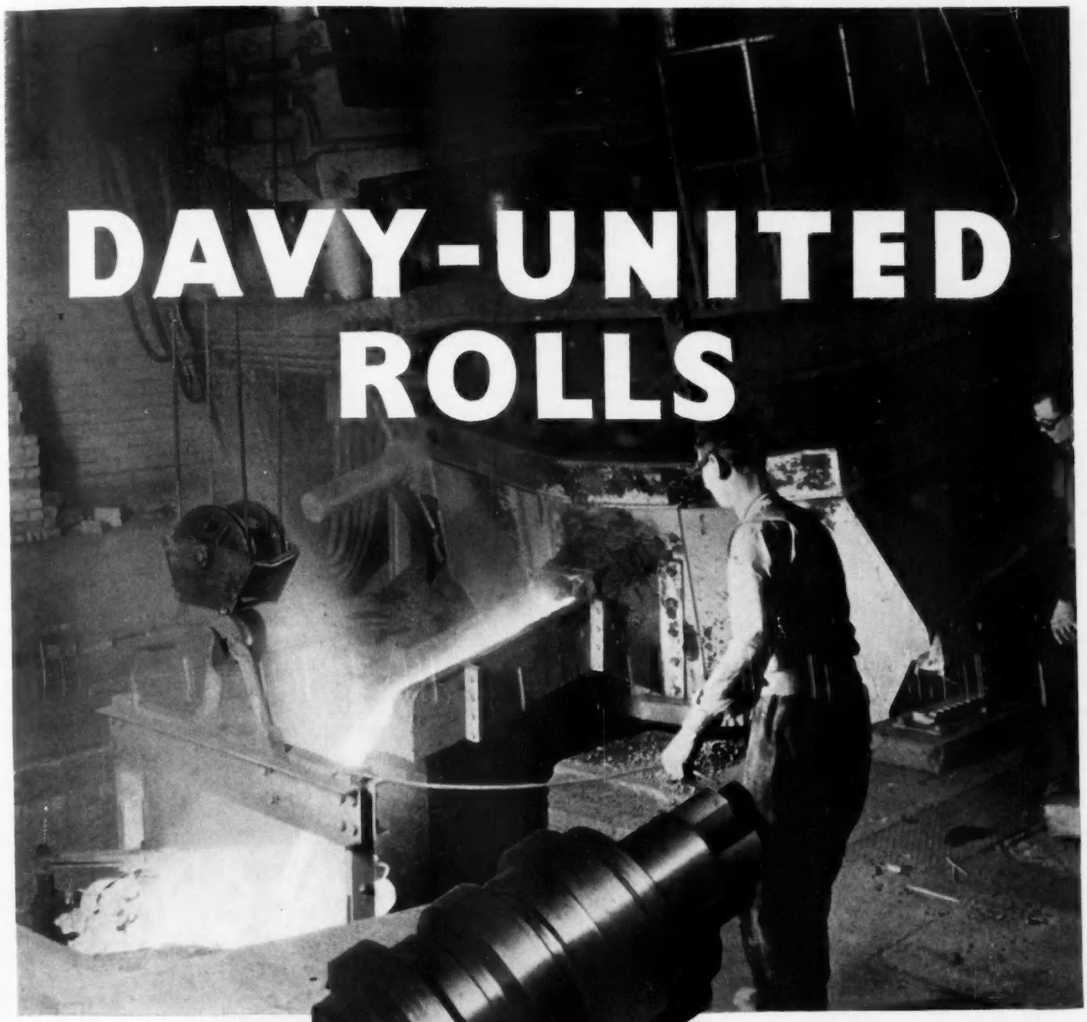
DAVY-UNITED ROLLS



Tapping one of our electric furnaces.

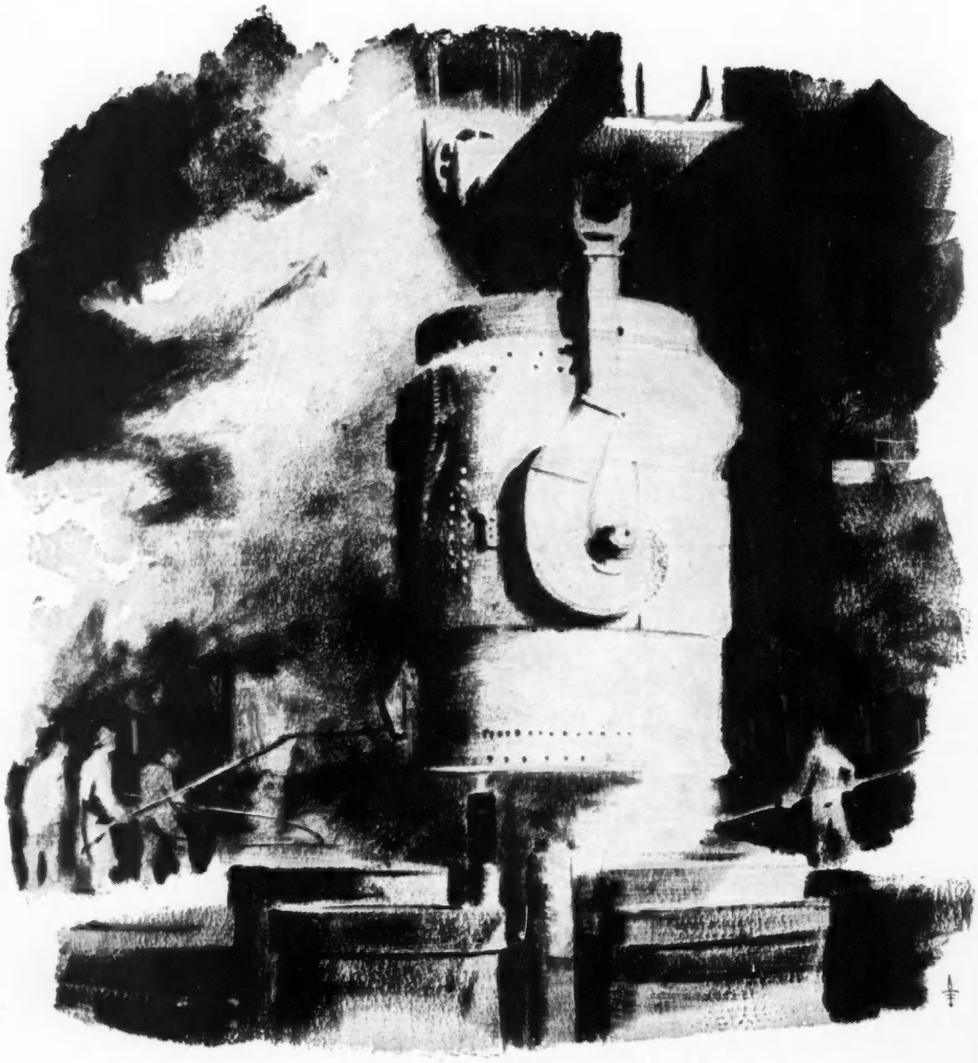
"XL" ALLOY
STEEL BASE ROLLS

HARDNESS RANGE: GRADE "A"—45/50° SHORE
GRADE "B"—38/45° SHORE

The range of Davy-United Rolls covers all types of Chilled, Grain, Steel Base and Cast Steel Rolls for the rolling of ferrous and non-ferrous metals.

DAVY AND UNITED ROLL FOUNDRY LIMITED, BILLINGHAM, CO. DURHAM

100/R



Quality from the raw material up to the finished product:

pig iron, semis, plates and plate products, bar steel, sections, strip, wide flats, permanent way materials, steel pipe, steel tubular products, Sicromal and other specialty steels, clad products By-Products: Ground-basic slag, slag products, especially blast furnace pumicestone slag and powdered blast furnace slag.

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VEREINIGTE HÜTTEN- UND RÖHRENWERKE DÜSSELDORF · GERMANY

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CLASSIFIED ADVERTISEMENTS SECTION.

For all advertisements classified under the headings of Tenders, Appointments Open, Situations Wanted, Patent Agents, Partnerships, Wanted, &c., Auction Sales, Publications For Sale, Miscellaneous and Public Notices, &c., the charge will be 12s. for the first four lines or under and 3s. per line up to one inch. When an advertisement measures an inch or more, the charge will be at the rate of 36s. per inch. 5% allowed on 6, 10% on 13, 15% on 26 and 20% on 52 Weekly insertions. If use is made of a box number the extra charge is 2s. per insertion with the exception of advertisements appearing under Situations Wanted. Prospectuses and Notices of Company Meetings £25 per column. Copy instructions must be in our hands first post Monday for the following Friday's issue. Address to the Manager, ENGINEERING LTD., 35 and 36, Bedford St., Strand, W.C.2. Inclusion of advertisements must be dependent on space being available.

EDUCATIONAL.

FREE. Brochure giving details of courses in Mechanical and Production Engineering, Draughtsmanship, etc., for the A.M.I.Mech.E., A.M.I.P.E., City and Guilds and other Professional examinations. E.M.I. INSTITUTES, DEPT. EG. 30, LONDON, W.4. (ASSOCIATED WITH H.M.V.) G 619

IMPERIAL COLLEGE.

BURSARIES FOR POSTGRADUATE STUDENTS.

Bursaries are available for Session 1956-57 to students normally resident in the United Kingdom for Courses of Postgraduate Study (not Research) in the following subjects:—

CIVIL ENGINEERING.
MECHANICAL ENGINEERING.
ELECTRICAL ENGINEERING.
CHEMICAL ENGINEERING.

Applicants must be graduates, who have spent at least one year away from University since graduation, preferably in Industry. The Bursaries will be of value £500 to £700, according to circumstances.

Applications should be sent to the DEPUTY REGISTRAR, CITY AND GUILDS COLLEGE, EXHIBITION ROAD, LONDON, S.W.7, not later than 30th June, 1956. M 35

COURSES.

THE POLYTECHNIC,
309, REGENT STREET, W.1.

SCHOOL OF ENGINEERING.

FULL-TIME DAY COURSES are available in Civil, Electrical, Mechanical and Telecommunications Engineering.

FULL-TIME COURSES prepare for diplomas in each of the above branches of engineering and for the B.Sc. (Engineering) degree of the University of London (External). These courses extend over a period of three to four years.

Session begins Tuesday, 18th September, 1956.

A prospectus may be obtained on application to the DIRECTOR OF EDUCATION. L 997

CONSULTANTS

DESIGN CAPACITY AVAILABLE

We have teams available to undertake design, detailing and development in the following fields:

Mechanical Engineering
Aeronautical Engineering
Special Machines and Projects
Servo Mechanisms and Automation
Mechanical Handling
Plant Layout
Production Tooling Etc.

The conception, design and development of **"BLUEBIRD"** was a special project undertaken by

NORRIS BROTHERS LTD.
53, VICTORIA STREET, S.W.1
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G661

CONSULTANTS WANTED.

BIRKBYS LTD., LIVERSEDGE, YORKS. Manufacturers of phenolic and similar plastic mouldings, require the services of a **CONSULTANT OR FIRM OF CONSULTANTS** in connection with the use of air for actuation and manipulation of moulding tools and finishing equipment. Please write personally to MR. J. N. STONE, DIRECTOR, BIRKBYS LIMITED. L 991

EXPERIMENTAL WORK.

RESEARCH ENGINEERS LIMITED,

Northampton Grove, Canonbury, London, N.1. Canonbury 4244/5/6. We have over 25 years' experience of experimental work and prototypes. We design, develop and manufacture special purpose and labour saving machines, all at the above address. Our range is from the smallest scientific instruments to 3- or 4-ton machines. After a prototype machine has been made and found satisfactory we can manufacture as many as are required. G 656

TENDERS.

THE DIRECTOR GENERAL, INDIA STORE DEPARTMENT, GOVERNMENT BUILDING, BROMYARD AVENUE, ACTON, LONDON, W.3, invites

TENDERS for the supply of:—

VERTICAL, HYDRAULIC-FEED, MULTI-SPINDLE, WOOD-PLANK BORING MACHINES, MOTORIZED 2 Nos.

Tender schedule and specifications may be purchased from the above address at a cost of ten shillings, quoting reference 5410/55/CIV.3.

Tenders complete with specifications are to be submitted by Friday, the 20th July, 1956. M 55

THE HIGH COMMISSIONER FOR INDIA invites **TENDERS** for the supply of:—

	Quantity, Nos.
AXLES—16 TONS, 10 IN. BY 5 IN. JOURNALS	1456
AXLES—12 TONS, 9 IN. BY 4½ IN. JOURNALS	76
AXLES—10 TONS, 7 IN. BY 4 IN. JOURNALS	261

Forms of tender may be obtained from the DIRECTOR GENERAL, INDIA STORE DEPARTMENT, GOVERNMENT BUILDING, BROMYARD AVENUE, ACTON, LONDON, W.3, on or after 15th June, 1956, at a fee of 10s. which is not returnable. If payment is made by cheque, it should please be made payable to "High Commissioner for India." Tenders are to be delivered by 2 p.m. on Friday, 20th July, 1956.

Please quote reference No. 59/56/RLY. M 56

PUBLIC APPOINTMENTS.

LONDON COUNTY COUNCIL.

ARCHITECT'S DEPARTMENT.

Vacancies for

ENGINEERING ASSISTANTS (up to £818) and **ENGINEER GRADE III** (up to £987) in the Structural Engineering Division. Work includes steelwork and reinforced concrete design and detailing for Council's buildings. Particulars and application forms from ARCHITECT (AR/EK/SE/1) THE COUNTY HALL, S.E.1. (1278). G 573

GOVERNMENT OF BRITISH GUIANA.

INSPECTOR OF LABOUR (FACTORIES) required to inspect factories, advise on legislation relating to working and safety conditions and train local officers. Experience as factory inspector essential with *either* degree or professional equivalent in mechanical or electrical engineering, *or* sound engineering experience including knowledge of steam boilers and pressure vessels. Three-year contract. Salary scale £950 to £1200 with lump sum gratuity (point of entry according to experience). Free passages. Generous leave, low Income Tax. Further particulars and application forms from DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, GREAT SMITH STREET, LONDON, S.W.1, quoting BCD. 132/30/01. Closing date for receipt of initial enquiries 12 July, 1956. M 4

SIERRA LEONE.

EXECUTIVE ENGINEERS.

PUBLIC WORKS DEPARTMENT.

Appointment on contract/gratuity terms. Gross emoluments in scale £1138 to £1857 p.a., plus gratuity of £150 p.a. Free Passages. Free medical attention for officer. Generous home leave. Low income tax.

Candidates should hold a University degree or diploma recognised as exempting from or have passed Final Parts I and II of the A.M.I.C.E. examination. Not less than two years practical experience in civil engineering design and/or works.

Apply—DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON, S.W.1. Give details of age, qualifications and experience. Quote BCD 112/15/02/D5. M 1

HERTFORDSHIRE COUNTY COUNCIL.

HATFIELD TECHNICAL COLLEGE,
Roe Green, Hatfield, Herts.

PRINCIPAL: Dr. W. A. J. CHAPMAN, M.Sc.(Eng.).

The following additions to the staff are required for September next, or as soon as possible thereafter.

DEPARTMENT OF AERONAUTICAL AND MECHANICAL DESIGN.

TWO LECTURERS IN MECHANICAL AND AERONAUTICAL ENGINEERING SUBJECTS. Opportunity for specialisation for Degree and H.N. Diploma work in Theory of Machines, Thermodynamics or Aeronautical subjects. (Ref. A/M.1).

TWO ASSISTANTS, GRADE B—one in Mathematics (Honours Graduate) and one in Engineering subjects (Ref. A/M.2).

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING.

TWO LECTURERS FOR HIGHER NATIONAL DIPLOMA, Higher National Certificate work in Mechanical and Production Engineering and Final City and Guilds Courses. (Ref. M/P.1).

ONE ASSISTANT, GRADE B, for similar range of work as above. (Ref. M/P.2).

ONE ASSISTANT, GRADE B, Welding and Sheet Metalwork, able to conduct classes to Final City and Guilds Courses. (Ref. M/P.3).

SALARY SCALES (subject to revision on October 1st next):

Lecturer:—£965 to £1065 per annum.
Grade B:—£525 to £820 per annum, starting point according to qualifications and experience, plus graduate and training additions.

Applicants for all the above posts should be well qualified academically and have good industrial and teaching experience. Further particulars and application instructions from the REGISTRAR. M 6

BOROUGH POLYTECHNIC,
BOROUGH ROAD, S.E.1.

PRINCIPAL: DOUGLAS H. INGALL, D.Sc., F.R.I.C., F.Inst.P., Hon.M.I.H.V.E.

DEPARTMENT OF MECHANICAL ENGINEERING.

The Governors invite applications for appointment as **LECTURER OR ASSISTANT, GRADE B,** in the Department of Mechanical Engineering. The persons appointed will be required to teach some of the following subjects to Higher National Certificate standard:

Mechanics, Heat Engines, Strength of Materials, Theory of Machines and Mechanics of Fluids.

Candidates should possess a degree of a British University or have some equivalent qualification, together with good industrial and teaching experience.

The salaries payable will be in accordance with the Burnham (Further Education) Report, 1954.

Further particulars and forms of application for appointment may be obtained by sending a stamped addressed envelope to the undersigned.

FREDK. J. PACKER,
CLERK TO THE GOVERNING BODY. M 8

CENTRAL ELECTRICITY AUTHORITY require a

SENIOR ASSISTANT ENGINEER in Civil Engineering Branch, Headquarters, S.E.1. Duties include critical examination and reporting on development of Projects, procedure leading to letting of contracts and consideration of prices and claims in respect of Power Station Construction. Candidates should preferably be C.M.Inst.C.E. and have field experience on major civil engineering works with Consulting Engineers or Contractors in Great Britain, preferably including work on power station construction. Knowledge is essential of methods of construction, administration of works, contract practice and procedure, costing and pricing of work and adjustment of claims. Salary within £1225 to £1575 p.a. inclusive. Applications stating age, present salary, full details of qualifications and experience, should be forwarded to D. MOFFAT, DIRECTOR OF ESTABLISHMENTS, WINSLEY STREET, W.1, by 29th June, 1956. Quote Ref.: ENG/834. M 9

CIVIL ENGINEERS.

EASTERN NIGERIA.

Vacancies exist for Civil Engineers for employment on Engineering projects, water supplies, design and construction, road development, etc.

Appointment on contract/gratuity terms with gross emoluments ranging from £1368 to £2094 p.a. plus gratuity payable on satisfactory completion of contract at the rate of £37 10s. for each 3 months service. Free Passages, Free medical and dental treatment. Generous home leave.

Candidates should have either (*a*) A University degree in Civil Engineering recognised by the Institution of Civil Engineers and two years subsequent experience or (*b*) passed Parts I and II Finals of the Institution of Civil Engineers examinations or an exempting diploma and have had a total of five years' general experience on civil engineering works.

Apply DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON, S.W.1. Give details of age, qualifications and experience. Quote BCD. 112/14/039/D5. M 3

PUBLIC WORKS DEPARTMENT
NORTHERN NIGERIA.

SENIOR EXECUTIVE ENGINEERS (ROADS).

Duties:—Control of a road construction organisation in the bush including construction of bridges, culverts, drainage works and the laying of bituminous surfacing.

Appointment on Contract/Gratuity terms. Gross salary £2448 p.a., plus gratuity, payable on satisfactory completion of contract, at rate of £37 10s. for each period of three months service (including approved leave). Free passages. Generous home leave.

Candidates should be Corporate Members of the Institution of Civil Engineers or hold a University degree recognised as exempting from the Final Parts I and II of the A.M.I.C.E. examination or equivalent qualification. They should have at least 15 years' practical experience of road and bridge construction and preferably some experience in a tropical country.

Apply DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON, S.W.1. Give details of age, qualifications and experience. Quote BCD 112/408/014/D5. M 2

DERBYSHIRE EDUCATION COMMITTEE.

CHESTERFIELD COLLEGE OF TECHNOLOGY.
Principal: E. CARDWELL, M.Sc. (Lond.), Wh.Ex., M.I.Mech.E.

Applications are invited for the following full-time posts with effect from the 1st September, 1956, or as soon thereafter as possible:—

ASSISTANTS, GRADE B, in the DEPARTMENT OF MECHANICAL AND CIVIL ENGINEERING—

1. To teach Mechanical Engineering subjects to Higher National Certificate level. Ability to teach Mathematics to A.1 standard an advantage.
2. To teach National Certificate subjects in Mechanical and Production Engineering together with Workshop Technology and Practice to final City and Guilds standard in Machine Shop Engineering.

SENIOR LECTURER in the DEPARTMENT OF ELECTRICAL ENGINEERING AND MATHEMATICS.

Candidates should possess an Honours Degree of a British University and have had experience in the teaching of Mathematics. The person appointed will be required to teach Pure and Applied Mathematics to B.Sc. (Eng.) standard and will be responsible for the organisation of the teaching of Mathematics throughout the College.

Salary will be in accordance with the Burnham Technical Report including additions for Graduates and allowances for teaching and approved industrial experience where appropriate. Further particulars and forms of application from the undersigned (stamped addressed foolscap envelope required), to whom applications should be returned by 3rd July, 1956.

S. A. BROADWELL,
REGISTRAR.

COLLEGE OF TECHNOLOGY,
INFIRMARY ROAD,
CHESTERFIELD. M 61

CHIEF ENGINEER.

SCHEME FOR NATIONALISATION OF OMNIBUS TRANSPORT IN CEYLON.

THE GOVERNMENT OF CEYLON requires the services of a

CHIEF ENGINEER to set up overhaul bases and repair depots suitably distributed throughout the Island for the maintenance of a bus fleet of about 3,500 buses of a nationalised undertaking which is to be established for the purpose of taking over the omnibus services from private ownership. The applicant should possess wide technical experience and should have held a responsible executive position in a road transport undertaking in the U.K. with a bus fleet of the size mentioned earlier. He should have considerable organisational ability to reorganise the existing garage facilities of about 80 private operators and establish new garages where necessary for the satisfactory maintenance of the bus fleet.

His main functions will be as follows:—

(*a*) to equip and run an efficient repair and maintenance organisation for the bus fleet mentioned earlier;
(*b*) to reorganise in the process the existing garage systems and facilities used by the private operators in the Island having regard to the new operational units in the nationalised scheme;
(*c*) to organise proper systems of costing and stores accounting;
(*d*) to draft and execute programmes of training for technicians where necessary.

The applicant should preferably be not more than 55 years of age and be prepared to serve in Ceylon for a minimum period of 5 years.

Background information on the problems involved will be supplied by the Ceylon High Commission on request.

Remuneration, leave, passages and other terms and conditions of employment will be determined by negotiation with the Ceylon Government through the Ceylon High Commissioner in the United Kingdom.

Applications should be addressed to the CEYLON HIGH COMMISSIONER, 13, HYDE PARK GARDENS, LONDON, W.2, and should contain the fullest possible information regarding the qualifications and experience of the applicant.

Applications close on 30th June, 1956.

13, HYDE PARK GARDENS, M 59
LONDON, W.2.

ADMIRALTY require **PRODUCTION ENGINEERS (UNESTABLISHED)** in various places in U.K. Various duties in production of mechanical, electrical and electronic equipment for H.M. Ships and include design for production, advice on production methods and preparation of estimates. Must have recognised apprenticeship or equivalent training, and possess a University Degree, A.M.I.Mech.E., A.M.I.E.E. or exempting qualifications. Age not less than 25. Salary scale £741 to £1160. Starting salary from £741 at age 25 up to £1018 according to age.—Forms, quoting C67/6A, from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1. G 668

FOREST PRODUCTS RESEARCH
PRINCES RISBOROUGH (D.S.I.R.),
requires

SCIENTIFIC OFFICERS. Ref. F.439/6A. Chemist or Chemical Engineer for work on wood preservation, Ref. C.440/6A. Two Engineers for problems concerned with the seasoning and machine cutting of wood, 1st and 2nd Class Honours degree or equivalent. Salary range (under review) £514-£935 (men). Ref. C.441/6A **ASSISTANT EXPERIMENTAL OFFICERS.** Two Engineers for work on the mechanical testing of wood and wood structures and on the mechanical cutting of wood. Ref. G.30/6A Botanist (male) for work on wood anatomy. G.C.E. advanced level in two Science or Maths. subjects or equivalent. Over 22, pass degree H.N.C. or equivalent generally expected. Salary range (under review) £328 (age 18)-£706. Women's salary ranges somewhat less but subject to improvement under Equal Pay Scheme.—Forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting appropriate reference No. M 50

PRINCIPAL LECTURER IN APPLIED MECHANICS at THE ROYAL NAVAL COLLEGE, GREENWICH. The Civil Service Commissioners invite applications from men for this established (i.e., pensionable) post, for appointment as soon as possible. Age at least 31 on 1st January, 1956. Candidates must possess a 1st or 2nd Class Honours Degree in Mechanical Engineering or equivalent and should have practical experience in Engineering. Knowledge of one or more of: (i) fluid mechanics including supersonics, (ii) aeronautics, (iii) servo-mechanisms, an advantage. Teaching experience desirable.

There may also be an unestablished post to fill in the same Department either as Principal Lecturer or Senior Lecturer. F.S.S.U. would apply to this post.

Salary: Principal Lecturer £1310-£1755, Senior Lecturer £1135-£1310. Exceptionally, starting pay above the minimum. Accommodation may be provided for an unmarried man. Salary scales and conditions of service are under review.

Secondment from Scientific Civil Service would be considered.—Further particulars and application forms from SECRETARY, CIVIL SERVICE COMMISSION, BURLINGTON GARDENS, LONDON, W.1, quoting No. 4600/56/10. Completed applications should be returned by 2nd July, 1956. M 51

LONDON ELECTRICITY BOARD.

CIVIL/STRUCTURAL ENGINEERING ASSISTANTS AND DRAUGHTSMEN.

Applications are invited for the above positions in the Construction Branch of the Chief Engineer's Department in Central London.

Conditions of service are in accordance with the National Joint Board agreement, Schedule " D," and salaries are inclusive of London Allowance.

Applicants for the positions of Assistants should have experience in the design and detailing of reinforced concrete for foundations, framed buildings, etc., or in the design and detailing of structural steelwork for buildings, etc. Salary within Grade 5 —£735 to £840 per annum.

Applicants for the positions of Draughtsmen should have experience in the preparation of drawings for either reinforced concrete or structural steelwork, or building work. Salary within Grade 6—£588 to £714 per annum.

Application forms obtainable from PERSONNEL OFFICER, 46, NEW BROAD STREET, LONDON, E.C.2. Please quote ref.: PER/V/2003/FF. M 18

STRUCTURAL ENGINEER FOR CANADA.

A STRUCTURAL ENGINEER is required for a permanent position with one of the senior engineering companies in Canada which is expanding steadily. Applicants should possess a degree in Civil Engineering and/or Associate Membership of either the Institution of Civil Engineers or the Institution of Structural Engineers. Age range 30 to 35.

The man chosen for this position will have had almost continuous experience since graduation on the engineering layout and design of structures and equipment for power stations including power house frames, switching and substation structures, transmission towers, head, sluice and regulating gates, stop logs, etc., and control or terminal buildings. Experience on the design of large penstocks and pipe lines or pressure tunnels would be considered an additional asset.

A positive requirement is a warm, pleasing personality with demonstrated ability to co-operate fully with other engineering staff and a flexible approach to engineering problems which in some cases are peculiarly Canadian. It is realized that economic conditions in the U.K. are such that full employment is available. However, we require a man having the excellent qualifications of an engineer trained in the U.K. This is a challenging opportunity and should be considered carefully by any engineer with the above qualifications and the desire to enjoy the refreshing atmosphere of Canadian living. The Company has excellent benefit plans—pension, life and medical insurance. Apply:—
DEPT. A. C. CANADIAN GOVERNMENT,
DEPT. OF LABOUR,
61, GREEN STREET,
LONDON, W.1. M 26

MIDDLESEX COUNTY COUNCIL.

EDUCATION COMMITTEE.

BOROUGH OF SOUTHALL.

Divisional Education Officer, Education Office, Villiers Road, Southall.
SOUTHALL SECONDARY TECHNICAL SCHOOL (BOYS).

Required in September, 1956,
GRADUATE ASSISTANT MASTER preferably with successful teaching experience to take APPLIED MATHEMATICS up to G.C.E. Advanced Level. Special Allowance subject to the provisions of the new Burnham proposals. Salary in accordance with Burnham Scale (London Area). Permanent post subject to satisfactory medical assessment. Application forms may be obtained by sending stamped addressed foolscap envelope to the DIVISIONAL EDUCATION OFFICER to whom completed forms should be returned within fourteen days of the appearance of this advertisement.

C. T. MILLER,
DIVISIONAL EDUCATION OFFICER. M 45

TECHNICIAN
required by the ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, BERKS, to assist on a technical section responsible for documentation and provision of technical advice to a Contracts Branch and Stores (department in respect of a wide variety of mechanical engineering stores, equipment and materials.

Applicants should have served a recognised apprenticeship and have had practical workshop experience. O.N.C. is desirable. Knowledge of standard specifications and experience of above work would be an advantage.

SALARY £691 (at age 28 or over) to £786 per annum.

Contributory Superannuation scheme. Married officers now living outside the Establishment's transport area will be eligible for housing on one of the Authority's estates or alternatively assistance towards legal expenses incurred in house purchase may be available, until housed a lodging allowance may be payable.

Requests for application forms by POSTCARD to the SENIOR RECRUITMENT OFFICER at the above address not later than 19th June, 1956. Please quote Ref. 1187/26. L 989

THE UNIVERSITY OF MANCHESTER.

Applications are invited for the post of
LECTURER IN ENGINEERING (CIVIL). Salary on a scale £650 by £50 to £1350 per annum; initial salary according to qualifications and experience. Membership of F.S.S.U. and Children's Allowance Scheme. Applications will also be considered from engineers who would be interested in a temporary appointment of two or more years. Applications should be sent not later than June 30th, 1956, to the REGISTRAR, THE UNIVERSITY, MANCHESTER, 13, from whom further particulars and forms of application may be obtained. M 16

STATE ELECTRICITY COMMISSION OF VICTORIA.

SENIOR POWER STATION STAFF.

The State Electricity Commission of Victoria seeks applications from engineers with the requisite qualifications and experience for appointment to its **SENIOR POWER STATION STAFF** in positions and at salaries commensurate with their qualifications and experience.

The salaries of Power Station Superintendents range from £A2166 (minor stations) to £A2566 (major stations) and Assistant Power Station Superintendents from £A1784 to £A2316 respectively. These salaries include the current cost of living adjustment of £A466 per annum and are the maxima for these positions.

The Commission is constituted as a semi-government authority by Act of Parliament and is one of the largest electricity supply authorities in the Commonwealth of Australia and is the largest producer of fuel with brown coal and briquette enterprises in the Latrobe Valley. It has a capital investment of approximately £200 million, with an annual revenue of £A29 million.

The major steam stations are situated in the Latrobe Valley approximately 90 miles east of Melbourne and in the Melbourne Metropolitan area. The minor steam stations are situated in the provincial cities of Ballarat, Geelong and Mildura. The rapid expansion of the Commission's system involves the construction of additional steam power stations of up to 500 MW capacity in the Latrobe Valley, burning brown coal.

Applicants should have the ability to deal with the day-to-day technical and administrative problems of a power station with its associated technical staff and labour forces and have had extensive experience in power station operation and maintenance. They should hold appropriate technical qualifications, but a University Degree or Higher National Certificate n Mechanical or Electrical Engineering, or membership of a recognised Engineering Institute is preferred.

A married appointee if allotted to the Latrobe Valley could be housed immediately; and in provincial cities, within a reasonable time of taking up duty. No assistance can be given in the matter of housing in Melbourne. The Commission will pay reasonable living expenses of married appointees and their families for a period of six months unless a house is obtained earlier.

Married appointees will be reimbursed at the expiration of six months' satisfactory service an amount of up to £A100 upon production of necessary receipts, in respect of removal of household furniture and effects.

Appointees and their families can be transported to Australia under the Commonwealth Government's Migration Scheme, details of which are available from officials at Australia House, The Strand, London.

Further information may be obtained on application to the Staff Superintendent at the address mentioned below.

Arrangements will be made for representatives of the Commission to interview selected applicants in England.

Applications, giving full details of qualifications experience and war service (if any), stating date of birth and accompanied by copies of testimonials, should be submitted not later than 21st July, 1956, to the Secretary:
STATE ELECTRICITY COMMISSION OF VICTORIA,
22-32 WILLIAM STREET, MELBOURNE, C.I.
VICTORIA, AUSTRALIA. L 993

UNIVERSITY OF BIRMINGHAM.

DEPARTMENT OF ELECTRICAL ENGINEERING.

Applications are invited for
TWO LECTURESHIPS IN ELECTRICAL ENGINEERING: qualifications should include a good university degree, preferably in Electrical Engineering, and a special interest in any branch of the subject. It is hoped that one of the posts can be filled by a man interested in acoustical engineering.

One post will be in Grade II with salary in the range £650 to £1350 (efficiency bar at £900), plus family allowance and membership of the F.S.S.U.; the other post is in Grade III with salary in the range £550 to £650, plus family allowance and membership of the F.S.S.U. Commencing salary may be at any point in the ranges according to qualifications and experience.

Three copies of applications, together with the names of three referees, should reach the REGISTRAR, THE UNIVERSITY, BIRMINGHAM, 15, not later than 7th July, 1956. Further particulars may be obtained from the Registrar.

G. L. BARNES,
SECRETARY,
THE UNIVERSITY,
BIRMINGHAM, 15. M 47

GOVERNMENT OF QATAR (PERSIAN GULF).

POWER STATION SHIFT ENGINEER.

Applications are invited for the appointment of a Power Station Shift Engineer in the State Electricity Department in Doha. The system includes a central Power Station with two 200, two 400 and three 550 kW diesel alternator sets with switchgear and ancillary equipment and distribution system with overhead lines and underground cables operating at 11 kV, 3.3 kV and 415 volt. Three further diesel alternator sets of 2,500 kW capacity each will be installed in the near future.

Candidates should hold an M.O.T. Certificate (Diesel) or equivalent qualification and must have had considerable previous experience in the operation and maintenance of large diesel engines.

TERMS AND CONDITIONS OF SERVICE.

Probationary period of six months during which the contract may be terminated at three months' notice by the Government. Contract for five years subject to successful completion of probationary period. The employee may terminate the contract by giving three months' notice in writing.

The salary scale is from Rs. 1475 per month, rising by annual increments of Rs. 75 to Rs. 1700 per month. The point of entry into the scale will be in accordance with the candidate's qualifications and experience.

A gratuity amounting to one month's salary for each completed year of service is payable on completion of contract only.

Free furnished accommodation, fuel, light and water. Married accommodation is provided after completion of probationary period.

Leave is earned at the rate of six days per completed month of duty and may be taken annually.

Free air or sea passages on first appointment, on leave and on final termination of contract are provided for applicant, wife and children up to 18 years of age.

Medical and dental treatment for the employee and his family are provided free.

A knowledge of Arabic would be an advantage and in any case the employee will be expected to apply himself to a diligent study of colloquial Arabic and to reach the standard of efficiency required by the Government regulations.

All calculations of pay and leave according to the Arabic calendar in force in Qatar.

Applications endorsed " Shift Engineer, Qatar," accompanied by full personal particulars including age, education, qualifications, experience, religion and past employment should be made in writing within 14 days of the date of this advertisement to the undersigned.

PREECE, CARDEW & RIDER,
8-12, QUEEN ANNE'S GATE,
WESTMINSTER, S.W.1. M 19

MECHANICAL AND ELECTRICAL ENGINEERS required for important projects at MINISTRY OF SUPPLY ESTABLISHMENTS in South of England. These include Research and Development on ram jet engines and gas turbine propulsive systems for supersonic speed; Mechanical and electrical devices for projectiles and rockets; instrumentation; aircraft and aircraft equipment. Candidates should have or be obtaining a 1st or 2nd class honours degree or equivalent in Mechanical or Electrical Engineering. Appointments as Scientific Officer (min. age 21) with salary according to age, experience, etc., in range £514 to £933 (Superannuable). Forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting C 436/6A. M 34

UNIVERSITY OF EDINBURGH.

APPLICATIONS are invited for the following posts in the Department of Engineering, to commence duties on 1st October, 1956:—

(A) LECTURER IN ELECTRICAL ENGINEERING primarily for teaching in the Post-graduate School of Electronics and Radio.

(B) LECTURER IN CIVIL ENGINEERING.

(C) LECTURER IN MECHANICAL ENGINEERING.

The salary scale is £700 by £50 to £1350 per annum, with an efficiency bar at £900, with superannuation benefit and family allowance where applicable. The commencing salaries will depend on qualifications.

Candidates should possess an Honours degree, together with industrial, teaching or research experience.

Further particulars may be obtained from the undersigned with whom applications, giving the names of two referees, should be lodged not later than 9th July, 1956.

JOHN MACPHERSON,
ASSISTANT SECRETARY TO THE UNIVERSITY
L 995

Classified Advertisements continued on Page 4

ELECTRONICS

By A. T. Starr, M.A., Ph.D., M.I.E.E. Written by an acknowledged authority, this book forms a comprehensive treatise on theoretical and applied electronics. Illustrated. 32/6 net.

"This is an outstanding textbook from the viewpoint of both teacher and student and one which is likely to be widely adopted." —The Electrical Journal.

PRACTICAL SHEET and PLATE METAL WORK

By the late E. Arthur Atkins. 6th Edition, revised by W. A. Atkins. 20/- net.

"The popularity of this book may be gauged from the fact that this is the sixth edition of a work which first appeared over forty years ago . . . to the amateur, the student and the professional, this book will be found invaluable."—The Metal Bulletin.

PITMAN

PARKER STREET, KINGSWAY, LONDON, W.C.2

STRENGTH OF MATERIALS

By F. V. Warnock, M.Sc., Ph.D., etc. 7th Edition. This book contains a large number of worked examples taken from recent examination papers of the University of London and Institutions of Civil and Mechanical Engineers. It covers the syllabuses of the B.Sc.(Eng.), I.C.E. and I.Mech.E., examinations in this subject as well as being a useful reference book. 22/6 net.

THE GANTT CHART

By Wallace Clark 3rd Edition. An invaluable book for British Industrialists and business executives 12/6 net.

"Those whose work is of a nature that falls within the field of this form of graphical presentation will find the volume of real assistance."—Times Trade antd Engineering Supplement.

LONDON COUNTY COUNCIL.

SOUTH EAST LONDON TECHNICAL COLLEGE, September.

LECTURER IN ELECTRICAL ENGINEERING to teach to H.N. Cert. and I.E.E., Part III standard. Should be graduate of British University, preferably with industrial and teaching experience. Burnham F.E. salary scales £1001 by £25 to £1113, commencing and maximum salary according to age qualifications and experience (scales at present under review). Application forms from SECRETARY AT COLLEGE, LEWISHAM WAY, S.E.4, returnable by 30th June. (1068) L 987

COUNTY BOROUGH OF BRIGHTON, EDUCATION COMMITTEE.

BRIGHTON TECHNICAL COLLEGE.

Principal: G. E. WATTS, M.A., Ph.D.(Cantab.), B.Sc.(Lond.), F.R.I.C.

Required for September 1st:—

ASSISTANT LECTURER (GRADE B) in Mechanical Engineering, Graduate, A.M.I.Mech.E. or A.M.I.Prod.E. Salary scale (under review), £525 by £25 to £820 (men), £489-£820 (women) plus graduate and training allowances and with increments for approved research, professional or industrial experience.

Further particulars and forms of application from the undersigned, to be returned to the PRINCIPAL, BRIGHTON TECHNICAL COLLEGE, BRIGHTON 7, as soon as possible.

W. G. STONE,
Director of Education.

54, OLD STEINE,
BRIGHTON. M 32

LONDON COUNTY COUNCIL.

PADDINGTON TECHNICAL COLLEGE.

ASSISTANT GRADE B TO TEACH MECHANICAL ENGINEERING SUBJECTS of ordinary and higher national certificates. Burnham F.E. salary scale £561 by £25 to £1012 (subject to review) individual starting and maximum salaries according to age, qualifications and experience. Application forms and further particulars from SECRETARY AT COLLEGE, SALTRAM CRESCENT, W.9, returnable by 30th June, (1015). L 984

ASSISTANT RESIDENT ENGINEER

required at Derby for supervision of bridge repair work and bridge construction contracts. Sound technical knowledge and experience in this class of work essential. Salary range £770 to £835.

Superannuation Scheme.

Residential and other travelling facilities available.

STRUCTURAL ENGINEERS

required in London and Manchester for bridge reconstruction work. Salary range £770 to £835. Good prospects for men of ability and initiative.

Superannuation Scheme.

Residential and other travelling facilities available.

Application to be made to CHIEF CIVIL ENGINEER, LONDON MIDLAND REGION, BRITISH RAILWAYS, 5A, EUSTON GROVE, LONDON, N.W.1. M 14

LONDON COUNTY COUNCIL.

WANDSWORTH TECHNICAL COLLEGE, September.

ASSISTANT GRADE B IN ELECTRICAL ENGINEERING to teach to Ordinary National Certificate and/or City & Guilds Electrical Technicians and/or Electrical Installations "B" standard. Burnham F.E. salary scale (now under review). Application forms from SECRETARY AT COLLEGE, WANDSWORTH HIGH STREET, S.W.18, returnable by 30th June, (1016). L 985

UNIVERSITY OF EDINBURGH.

APPLICATIONS are invited for the following posts in the Department of Engineering, to commence duties on 1st October, 1956:—

(A) ASSISTANT IN ELECTRICAL ENGINEERING.

(B) ASSISTANT IN MECHANICAL/CIVIL ENGINEERING.

The salary scale is £550 by £50 to £650 per annum, with superannuation benefit and family allowance where applicable. Appointment is normally for three years. The commencing salaries will depend on qualifications. The duties of an Assistant correspond to those of an Assistant Lecturer in an English University. The successful candidate will be encouraged to study for a higher degree. Candidates should possess an Honours Degree. Previous industrial or research experience though not essential would be an advantage.

Further particulars may be obtained from the undersigned, with whom applications, giving the names of two referees, should be lodged not later than 9th July, 1956.

JOHN MACPHERSON,
ASSISTANT SECRETARY TO THE UNIVERSITY L 996

LONDON COUNTY COUNCIL.

HACKNEY TECHNICAL COLLEGE, September, 1956.

VISITING TEACHER (S) for N.C. Mechanical Engineering Classes as follows—7—9.15 p.m.:—Mon. A.2.—Machine Tools and Metrology, Tues. A.1.—Workshop Technology, Fri., S.3—Workshop Technology. Rates of pay A.2—51s. 3d., A.1—51s. 3d., S.3—41s.3d., per evening. Applications to HEAD OF ENGINEERING DEPT., AT COLLEGE,8 DALTON LANE, E.8. (1066). L 986

CENTRAL ELECTRICITY AUTHORITY, MIDLANDS DIVISION.

THIRD ASSISTANT ENGINEER (MECHANICAL) is required in the Generation Construction Department at Headquarters, Birmingham. N.J.B. service conditions, superannuable appointment, salary within Schedule "B" Grade 4 of the Agreement, commencing in range £810 to £935 and ultimately rising to £1010 per annum.

The successful applicant will be engaged on work concerned with the design and construction of mechanical equipment for generating stations, including boilers, turbo-alternators and ancillary plant. Appropriate technical qualifications will be an advantage.

Apply quoting Vacancy No. 361MD on form AE6, available from the ESTABLISHMENTS OFFICER, 53, WAKE GREEN ROAD, MOSELEY, BIRMINGHAM, 13, by 27th June, 1956. M 41

NORTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD.

ENGINEERING ASSISTANT (MECHANICAL) required. Applicants must have O.N.C. or other approved qualification in mechanical engineering. Salary scale: £480 (age 21 and over) by £20 (7) by £25 (2) to £670 plus £20 to £30 London Weighting. Improved scale awaited. Starting salary above minimum may be paid for suitable experience since obtaining appropriate qualification. Superannuable. Whitley Council conditions.

Apply, giving age, qualifications (with date) and experience, with names and addresses of two referees, to SECRETARY, NORTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD, 11a, PORTLAND PLACE, W.1, by 5th July. M 70

CITY OF LEICESTER.

EDUCATION COMMITTEE.

COLLEGE OF TECHNOLOGY AND COMMERCE.

PRINCIPAL: R. E. WOOD, M.Sc., F.Inst.P.

Applications are invited for the post of **FULL-TIME ASSISTANT GRADE B,** in the Department of Mathematics from September, 1956.

Candidates should be graduates in Mathematics, Engineering or Science, with teaching or industrial experience.

The work will be concerned with the teaching of Mathematics to Engineering students up to Ordinary National Certificate and some General Certificate of Education Advanced work.

Salary in accordance with the Burnham Scale for Grade B Assistants, i.e., £525 rising by £25 to £820 per annum, with additions for degree and training and immediate increments for approved teaching and industrial experience.

Further particulars and application forms may be obtained from THE REGISTRAR, COLLEGE OF TECHNOLOGY AND COMMERCE, THE NEWARKE, LEICESTER, to whom applications should be returned within two weeks of the appearance of this advertisement.

ELFED THOMAS,
Director of Education. M 78

NORTHAMPTON COUNTY BOROUGH EDUCATION COMMITTEE.

COLLEGE OF TECHNOLOGY.

Wanted in September, or as soon as possible thereafter:—

A TEACHER OF MOTOR VEHICLE ENGINEERING subjects to prepare students for City and Guilds examinations. Salary—Burnham Scale, Grade A.

Application forms and further particulars may be obtained from:—

H. A. SKERRETT,
Chief Education Officer.

"Springfield,"
Cliftonville,
Northampton. M 79

FITTING & MACHINE TOOL INSTRUCTOR required by N.C.B's Mines Mechanisation Training Centre, West Bar, Sheffield, with a sound practical knowledge of engineering. Teaching experience and H.N.C. would be an advantage. Appointment (superannuable), within range £650 to £750, according to qualifications and experience.

Write, with full particulars of age, education, qualifications and experience, to NATIONAL COAL BOARD, STAFF DEPT., HOBART HOUSE, LONDON, S.W.1, marking envelope SS/312, before 28th June, 1956. M 63

SOUTH OF SCOTLAND ELECTRICITY BARD.

Applications are invited for the position of **SECOND ASSISTANT ENGINEER (MECHANICAL)** in the Generation/Construction Section of the Chief Engineer's Department.

Applicants should preferably hold a degree in Electrical or Mechanical Engineering, and be Corporate Members of the Institution of Electrical Engineers or the Institution of Mechanical Engineers, or have equivalent qualifications.

They should have had experience in the design and construction of turbo-generators, boilers, coal and ash handling plant, high pressure steam and water piping and other ancillary work, and knowledge of electrical equipment associated with modern Power Stations.

Experience in the preparation of specifications and estimates and analysis of tenders would be an advantage.

Salary—National Joint Board Agreement, Schedule "B" Class AX/DX Grade 2—£1015 to £1230 per annum.

The position is superannuable. Application should be made on the standard application form, which may be obtained from the undersigned and returned not later than 14 days from the date of appearance of this advertisement.

J. MEEK,
Secretary.

P.O. Box 173,
351, Sauchiehall Street,
GLASGOW, C.2. M 82

KENYA.

CIVIL ENGINEERS.

PUBLIC WORKS DEPARTMENT.

Appointment on contract/gratuity terms. Emoluments in scale £1135 to £1782 p.a. Substantial gratuity on satisfactory completion of contract. Free Passages: Free Medical Attention. Generous home leave.

Candidates should hold a University degree or diploma recognised as exempting from or have passed Final Parts I and II of the A.M.I.C.E. examination and have had general Hydraulic experience on water supply.

APPLY DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON, S.W.1. Give brief details of age, qualifications and experience. Quote BCD 112/7/018/D5. M 67

KENYA.

ENGINEERS, MATERIALS BRANCH.

PUBLIC WORKS DEPARTMENT.

Appointment on contract/gratuity terms. Gross emoluments ranging from £1135 to £1782 p.a. Substantial gratuity on satisfactory completion of contract. Free passages; Free medical attention. Generous home leave; low Income Tax.

Candidates, who should be under 40 years of age must:—

(*a*) hold a recognised university degree or diploma in Civil Engineering carrying exemption from Final Parts I and II of the A.M.I.C.E. examination or be A.M.I.C.E. and have had at least two years approved practical experience, of which at least one year must have been spent on materials testing and control, soils, concrete, bitumen, etc.; or

(*b*) possess an honours degree in Physics including Pure and Applied Mathematics, and a sound knowledge of Electronic and light Electrical Engineering.

For the selected candidate holding qualification (*a*) duties will mainly involve the control and execution of tests in the laboratory and field on soils, soil stabilisation and on materials used on buildings, roads, and water construction works; the selected candidate holding qualification (*b*) will be required to undertake the testing of materials by electronic and light electrical engineering methods.

APPLY DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON, S.W.1. Give details of age, qualifications and experience. Quote BCD. 112/7/04/D5. M 66

NATIONAL COAL BOARD.

DURHAM DIVISION.

METHOD STUDY ENGINEERS.

DIVISIONAL METHOD STUDY ENGINEER.

A Divisional Method Study Engineer is required to introduce and co-ordinate Method Study in the six Areas of the Division.

Applicants should have professional engineering qualifications, preferably in coal mining (Mining Degree and First Class Certificate of Competency) although Mechanical, Electrical, Civil and Metalliferous Mining Engineers will be considered. Preference will be given to men who have had considerable Managerial experience in a large organisation.

Experience of Method Study or Production Engineering is desirable, but training will be given to otherwise suitable men lacking this experience.

Salary on appointment will be according to qualifications and experience within the range £1750 to £2250.

AREA METHOD STUDY ENGINEERS.

The duties of the post include the responsibility for the introduction of Method Study techniques at collieries in the Area and lecturing at Training Courses, etc. Some travelling will be involved.

Applicants should have a Mining Engineering qualification or a good degree in Engineering or Science or some equivalent qualification. Recent experience at a senior level in Method Study or Production Engineering would be a decided advantage.

Salary on appointment will be according to qualifications and experience within the range £1400 to £2000.

Applications, stating age, education and experience and specifying post or posts applied for to be submitted within 7 days of publication to the STAFF DIRECTOR, N.C.B., DURHAM DIVISION, 7 SIDE, NEWCASTLE ON TYNE, 1. M 95

UNIVERSITY OF BIRMINGHAM.

DEPARTMENT OF CIVIL ENGINEERING.

Applications are invited for

A LECTURESHIP IN CIVIL ENGINEERING.

The appointment will be in Grade II (salary £650 by £50 to £1350 p.a. with efficiency bar at £900, according to qualifications and experience, plus F.S.S.U. and family allowance). Applicants should have experience in Structures or Strength of Materials. Time and facilities will be available for research work.

The lecturer will be required to take up his duties not later than 1st October, 1956. Applications should be submitted by 7th July, 1956, to THE REGISTRAR, THE UNIVERSITY, BIRMINGHAM, 15, from whom further particulars may be obtained.

G. L. BARNES,
Secretary.

The University,
Birmingham, 15. M 85

UNIVERSITY OF BIRMINGHAM.

DEPARTMENT OF CIVIL ENGINEERING.

Applications are invited for a

LECTURESHIP IN TRAFFIC ENGINEERING.

The appointment will be in Grade II (salary £650 by £50 to £1350 p.a. with efficiency bar at £900, according to qualifications and experience, plus F.S.S.U. and family allowance).

The lectureship will be known as the Paviors Company Lectureship in Highway Engineering, and the lecturer will be expected to lecture on Traffic Engineering to the Post-Graduate School in Highway Engineering, organise laboratory work in this subject and supervise research; he will also be expected to take part in traffic engineering instruction of undergraduate students.

Applications should be submitted by 7th July, 1956, to THE REGISTRAR, THE UNIVERSITY, BIRMINGHAM, 15, from whom further particulars may be obtained.

G. L. BARNES,
Secretary.

The University,
Birmingham, 15. M 86

THE PAISLEY TECHNICAL COLLEGE, George Street, Paisley.

Applications are invited from

CIVIL, ELECTRICAL AND MECHANICAL ENGINEERS, CHEMISTS, PHYSICISTS AND MATHEMATICIANS, who hold an honours degree of a British University or equivalent qualification, for appointment to the lecture staff in various departments of the College.

MAXIMUM SALARY £1316 PER ANNUM (UNDER REVIEW). Successful candidates will be offered subject matter, to suit their preferences, relative to full-time students reading for degrees and to part-time students in Higher National Certificate Courses.

Further information may be obtained on enquiry at the College.

H. N. HENRY,
PRINCIPAL. M 91

CITY OF CARDIFF EDUCATION COMMITTEE

COLLEGE OF TECHNOLOGY AND COMMERCE.

PRINCIPAL—DR. A. HARVEY, B.Sc., F.Inst.P.

ENGINEERING DEPARTMENT.

Applications are invited for the post of **ASSISTANT LECTURER, GRADE B,** duties to commence 1st September.

Candidates should hold recognised qualification in Mechanical or Production Engineering and should state in their application which subjects they are qualified to teach.

Present salary £525 to £820 p.a., plus training and graduate allowances. Initial salary depends on previous experience. Salary scale under review.

Further particulars and forms of application may be obtained from the undersigned, on receipt of a stamped addressed foolscap envelope. Applications should be returned as soon as possible.

ROBERT E. PRESSWOOD,
DIRECTOR OF EDUCATION.

City Hall,
Cardiff. M 93

New Book

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DR. C. JAEGER

An attempt has been made in this book to cover the methods of analysis and calculation required for the design of water-power schemes. The selection of the material has been based on many years' experience of this type of work. The numerous references are intended to give the reader some insight into the historical development of hydraulics. This is a translation from the German which has been read and approved by the author who has taken the opportunity of revising the original text and making some additions to both text and diagrams.

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Applications, giving names of two referees and quoting reference No. 35/16, to be delivered to COUNTY SURVEYOR, COUNTY HALL, PRESTON, by the 2nd July, 1956. M 98

CANCELLED ADVERTISEMENT.

NORTHAMPTON POLYTECHNIC, LONDON, E.C.1.

APPOINTMENT OF PRINCIPAL.

The advertisement for the post of Principal, included in ENGINEERING, page 5, dated June 8, 1956, is temporarily withdrawn. M 83

MECHANICAL ENGINEERING DRAUGHTSMEN
and
CIVIL ENGINEERING DRAUGHTSMEN
IMPERIAL CHEMICAL INDUSTRIES LIMITED BILLINGHAM DIVISION

offer attractive salaries in respect of several vacancies for each of the above classes of draughtsmen. Candidates must possess as a minimum qualification, the appropriate Higher National Certificate or its equivalent. Participation in Staff Pension Fund and Profit-Sharing Scheme. Financial assistance towards removal expenses available for married men. Without commitment, write for Application Form to the STAFF MANAGER, IMPERIAL CHEMICAL INDUSTRIES LIMITED, BILLINGHAM DIVISION, BILLINGHAM, CO. DURHAM, quoting reference R.17. G 666

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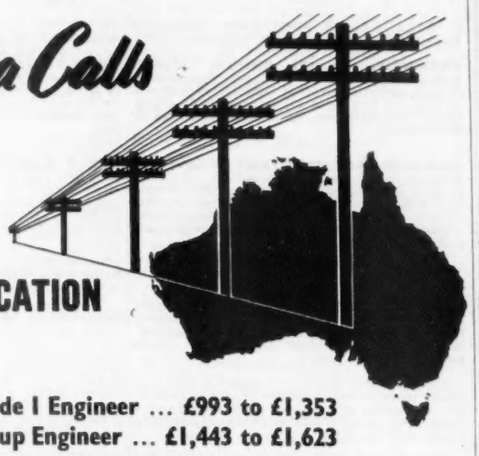

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SPECIAL : A particular position of Group Engineer T.V. transmission is available for an experienced man.

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STAFFS. L 778

STRUCTURAL ENGINEER
required

with experience in prestressed concrete, to take charge of small drawing office and assist in development work.

Salary £1000 to £1250 according to experience.

Applicants should send details of qualifications and experience to :—

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Applicants willing to accept assignments for a limited initial period of three to five years in Canada, Africa or New Zealand are invited to apply. Age not over 40. Remuneration on a high scale with superannuation and expense allowances.—Full details of qualifications and experience to the PERSONNEL MANAGER, BOX L 736, Offices of ENGINEERING.

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Large Electrical Cable Manufacturers, N. London, require
PLANT LAYOUT ENGINEER. Applicants must be fit and have considerable experience of layout of plant and all services. Previous cable factories experience desirable but not essential.—Write full details, past experience, salary required and availability to Chief Works Engineer, BOX L 941, Offices of ENGINEERING.

APPOINTMENTS OPEN.

STRUCTURAL ENGINEER required by London firm of Consultants to take charge of their steel design office. Candidates must have a comprehensive knowledge of all types of structural steelwork both designing and detailing and should preferably have had some works experience. Applicants should be Corporate Members of one of the senior professional Institutions or hold similar Degrees. The post is a permanent one and there is a Staff Pension Scheme.—Please reply in confidence to BOX NO. 886, GLOVERS ADVERTISING, LTD., 351, OXFORD STREET, W.1. G 645

MANAGEMENT AND INDUSTRIAL CONSULTANTS
engaged in all types of Production, Organisation, Administrative and Costing functions are open to **ENGAGE ADDITIONAL STAFF.** Applicants must possess highest technical and professional qualifications in Engineering or Accountancy and should have practical managerial experience. Age not over 40. Remuneration on a high scale with superannuation and expense allowances.—Full details of qualifications and experience to BOX L 737, Offices of ENGINEERING.

JIG AND TOOL DRAUGHTSMEN

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Rented housing accommodation available in the New Town for successful applicants.

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Classified Advertisements continued on Page 6

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Foreword by Professor R. H. EVANS, D.SC. D.ÈS.SC., PH.D., M.I.C.E., A.M.AM.SOC.C.E., M.I.MECH.E., M.I.STRUCT.E.

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★ *The work of the Company covers a wide and interesting field including*

(*a*) **The design, layout and installation of large-scale chemical plants, and**

(*b*) **the design of special purpose machines and equipment for the application of cutting and welding techniques.**

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Vacancies exist for Designers and Draughtsmen with experience in any of the following fields:

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SPECIAL PURPOSE MACHINES · GENERAL MECHANICAL ENGINEERING

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Applications, giving full details of experience, qualifications and salary required, to the Staff Officer, British Oxygen Engineering Ltd., Angel Road, Edmonton, N.18

L 909

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require

(o) AIRCRAFT SPARES SCHEDULE COMPILERS

(at Weybridge and Hurn)—suitable ex-R.A.F. personnel required or civilians with airframe maintenance experience.

(p) ESTIMATORS (Senior)

for general aircraft work.

Applications, quoting date and prefix letter of advertisement to: EMPLOYMENT MANAGER, VICKERS - ARMSTRONGS (AIRCRAFT) LIMITED, WEYBRIDGE WORKS, WEYBRIDGE, SURREY. L 971

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Apply O. W. ROAKILL, INDUSTRIAL CONSULTANTS, 14, GREAT COLLEGE STREET, S.W.1. L 992

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Applications should be sent to the Group's Head Office, addressed to:—

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L 813

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Applicants must prove a successful record in a similar capacity, and should not be over 45 years of age. Only those with experience of Modern Machine Techniques, Assembly and Layout, and of managing a large staff need apply.

The position is superannuated, carries substantial remuneration, and presents first-class opportunities for advancement.

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L 859

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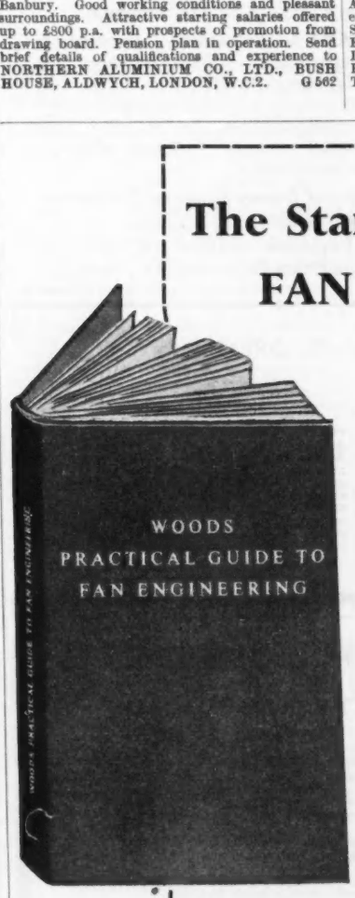

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The immediate vacancies are in the Design Office for :—

ASSISTANT TECHNICAL OFFICERS
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The appointments are to permanent staff and the Company is anxious to engage men who have had first rate experience to assist with the long-term plans for further development. Candidates in this category will be invited to interview, without commitment, at the Company's expense.

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Wilton is situated at the foot of the Cleveland Hills in Yorkshire, five miles from the coast. Working conditions are good and recreation facilities, including golf, tennis and badminton, are available.

Write for application form to: Staff Manager, Imperial Chemical Industries Limited, Wilton Works, Middlesbrough, Yorkshire, quoting advertisement reference ICI/X/302/e. L 541

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aged 25 or over. Preferably experienced in process layout works for medium sized machining operations in large quantities. O.N.C. preferable, but not essential.

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Aged 28 years or over with at least 5 years mass production on modern machine tools, preferably with the automobile industry. Applicants should have O.N.C. as a minimum qualification. Must be capable of working entirely without supervision and able to prepare detailed estimates.

PLANT DRAUGHTSMEN

Aged 24 or over. Preferably O.N.C. Experienced in detail design involving some structural steel work and sheet metal work. Applicants should have had some experience in maintenance of plant and buildings.

Rented housing accommodation available to successful applicants.

Good salary and conditions; Pension Scheme; Sports Club; Canteen facilities. Write giving age and full details of experience to LABOUR MANAGER. M 69

ROLLING STOCK DRAUGHTSMAN required, experienced in the design of various types of railway vehicles. Pension Scheme.—Apply stating age, experience and salary required to R. Y. PICKERING & CO., LTD., WISHAW, LANARKSHIRE, SCOTLAND. L 967

EXPERIENCED PLANNING ENGINEERS required for production methods on medium I.C. engine components and fuel injection equipment. Pleasant working conditions, generous salary. Attractive Pension Scheme and Comprehensive Welfare Facilities.
Apply CHIEF PERSONNEL OFFICER, PETTERS LIMITED, CAUSEWAY WORKS, STAINES, MIDDX. G 662A

SENIOR MECHANICAL ENGINEERING DRAUGHTSMEN required for interesting work on large chemical plant installations. Experience in this type of work is desirable but not essential, applicants with general mechanical engineering experience will be favourably considered. The posts offer excellent opportunities with generous salaries commensurate with experience and ability. Offices situated in the N.W.1 London area. Five-day week and superannuation scheme. Applications, which will be treated in confidence, should give previous experience and qualifications, and be addressed to the CHIEF DRAUGHTSMAN, LAPORTE CHEMICALS LIMITED, CLIFTON HOUSE, EUSTON ROAD, LONDON, N.W.1. G 664

STRUCTURAL ENGINEER with wide experience of the design and detailing of all types of steel structures and with administrative experience required to act as deputy to the Chief Engineer by large firm of London Consultants. The firm is expanding and the vacancy offers excellent opportunities for the right type of man.—Write in confidence giving details of previous experience and salary required to BOX No. 355, GLOVERS ADVERTISING LTD., 351, OXFORD STREET, LONDON, W.1. G 635

WELL QUALIFIED ENGINEER with Tea Machinery experience required as Visiting Engineer in Africa. Reply, giving fullest details of qualifications and experience to.—BOX M 46, Offices of ENGINEERING.

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COURTAULDS LIMITED requires a **DESIGN ENGINEER** at its Engineering Headquarters in Coventry for development work on man-made fibre-making plant and machinery. A good engineering degree is essential, and several year's industrial experience in the design and development of chemical, textile, or allied process plant and machinery is desirable. Age 27 to 40. Applicants should have an aptitude for solving design problems and calculations in this type of engineering.
Candidates should write giving full personal particulars and details of experience to the DIRECTOR OF PERSONNEL, COURTAULDS LIMITED, 16, ST. MARTINS-LE-GRAND, LONDON, E.C.1, quoting reference number B.36. L 925

SENIOR VACANCY FOR A

MECHANICAL ENGINEER

A Mechanical Engineer, preferably aged 30 to 40 years, with production engineering experience and technical qualifications equivalent to Honours degree standard is required by a large chemical firm to manage, and in part re-organise, their engineering shops which deal primarily with maintenance of chemical plant ranging from light precision engineering to heavy high pressure forgings. Experience of instrument maintenance and manufacture would be an acceptable additional qualification. Ability to handle staff and men and to create and inject life into his own organisation is essential.

For this senior appointment, which is permanent and pensionable, the starting salary will be in a range up to £2000.

For a married man some assistance can be given towards house purchase and removal expenses.

Write giving full details of age, qualifications and experience to BOX M 92, Offices of ENGINEERING, quoting reference U.6.

DRAUGHTSMEN required for Mechanical Engineering Department of Aylesford Paper Mills. Experience of plant layouts would be an advantage but is not essential. Minimum qualification O.N.C. Excellent terms and prospects. Applications stating age, experience and qualifications should be addressed to THE PERSONNEL OFFICER, ALBERT E. REED & CO. LTD., AYLESFORD PAPER MILLS, LARKFIELD, NR. MAIDSTONE. M 33

ENGINEER SURVEYOR required by Insurance Company for inspection of Cranes and Lifting Plant in the Glasgow and South Scotland area. Must have Drawing Office experience in design of Cranes and National Certificate in Mechanical Engineering. Salary £675 p.a., rising to £1000. Pension (non-contributory). Write BOX E 748 LPE, 55, ST. MARTIN'S LANE, LONDON, W.C.2. M 48

ESTIMATOR (SENIOR) required by Steel Pipe Manufacturing Firm in S.W. England. Progressive position. Pension scheme. Salary, £800-£1000 p.a. —BOX L 797, Offices of ENGINEERING.

DESIGN DRAUGHTSMEN. The British Drug Houses Ltd. invite applications from suitably qualified men for interesting work in their Engineers Drawing Office, on special machines and plant layouts for the Light Chemical Industry. Higher National Certificate in Mechanical Engineering and previous experience in this industry desirable but not essential. Men of mature age with suitable training and experience would be considered. Five-day week. Pension and Profit Sharing Schemes.—Write stating age, experience and salary required to STAFF MANAGER (REF. B8945), GRAHAM STREET, CITY ROAD, N.1. L 918

IMPERIAL CHEMICAL INDUSTRIES LIMITED
METALS DIVISION
KIRKBY WORKS

MANAGER OF THE ENGINEERING DEPARTMENT AND WORKS ENGINEER

Applications are invited from Engineers who wish to be considered for appointment as Manager of the Engineering Department and the Works Engineer of the Kirkby Works, a new plant situated some 5 miles east of Liverpool.

This modern factory manufactures non-ferrous tubes in a variety of sizes and is equipped with some of the latest automatic machinery involving a high degree of instrumentation and mechanisation.

While plant maintenance will absorb a large part of the Works Engineer's time, it is the intention that he should devote appreciable effort to engineering development and modifications to existing machinery to improve its output and performance. In this he will have the assistance of Technical Staff from the Division Engineering Department and Production and Technical Department.

The applicants should be men of about 35 years of age with experience either as Works Engineer in a small works or as an Assistant Works Engineer in a larger one. They should possess an Engineering degree and should preferably have had design experience. A system of Scheduled Maintenance is in operation andexperience in the administration of such methods would be an advantage though not entirely essential. The successful applicant will be responsible for the administration of the Engineering Department employing some 25 staff and 250 work people, and in addition will be expected to maintain a realistic balance between economic operation and engineering requirements.

The appointment will be to the permanent staff of the Company and will carry membership of the Company's Staff Benefit Schemes including Pension and Profit Sharing. The salary is appreciable and is consistent with the degree of responsibility involved. After joining the staff, married men will receive a reasonable refund of removal (including travel) expenses, and to assist in house purchase, facilities are available in approved cases for loans; in addition legal charges may be advanced.

Application forms may be obtained from the Staff Manager, IMPERIAL CHEMICAL INDUSTRIES, LIMITED, METALS DIVISION, KYNOCH WORKS, WITTON, BIRMINGHAM, 6, quoting ENG/26/ENG. M 101

MECHANICAL ENGINEERING DRAUGHTSMEN required with training in Maintenance, Building and Mechanical problems. A knowledge of machine design would be an advantage. The positions are pensionable and progressive. Applications stating qualifications, age and previous experience should be addressed to the WORKS PERSONNEL OFFICER, PILKINGTON BROTHERS LIMITED. RAVENHEAD WORKS, ST. HELENS, LANCASHIRE. M 36

Large Oil Company requires
ASSISTANT ENGINEER, AGE 27-35 for London office, with following qualifications:—
(1) Associate Membership, Institution of Naval Architecture; or
(2) H.N.C. in Naval Architecture; or
(3) 1st Class M.O.T. Certificate with endorsement.

Shipyard apprenticeship should have included hull construction and engining. Experience in design, construction and engining of coastal, inland waterways or small naval craft, essential; knowledge of the operation and/or maintenance of barge or coaster fleets an advantage.
Opportunities exist for overseas service. Starting salary according to age and experience. Pension Fund. Write giving full details to BOX ZP. 597, DEACON'S ADVERTISING, 36, LEADENHALL STREET, LONDON, E.C.3. M 37

SENIOR JIG AND TOOL DRAUGHTSMEN required for Tool Design on
(*a*) Small I.C. Engine components.
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SHEEPBRIDGE ENGINEERING LIMITED, CHESTERFIELD, offer attractive opportunities for
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capable of upgrading to project work; experienced in Material Handling Plant for Quarries and Collieries. Applications from Designers and Draughtsmen with qualifications in General Engineering will also be given consideration for duties of a suitable nature. Progressive superannuated positions, attractive salaries commensurate with qualifications and experience, with provision of houses for senior positions if required.—Apply, giving details of qualifications, experience, etc., and quoting reference EQD, to the PERSONNEL MANAGER. L 935

Classified Advertisements continued on Page 146

Photograph by courtesy of Messrs. Aplin & Barrett Ltd.

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Among the many factories in which we have installed "Visco" Ventilation Equipment is that of Messrs. Aplin & Barrett Ltd., Yeovil, makers of the famous St. Ivel Products.

The above photograph shows the Equipment comprising Centrifugal Fan, "Visco" Duplex Air Filter and Air Heater Battery, for supplying filtered and tempered air to the Lactic Cheese Room. In the background can be seen part of another "Visco" Ventilation Plant installed some years ago.

We have installed somewhat similar "Visco" Equipment in many other industrial plants—steel works, chemical works, colliery buildings, a chromium plating works, a sewing machine factory, etc.

We invite you to write for Publication No. 523

Air-Conditioning Plant for Sterile Rooms, capacity 8,500 c.f.m. (supplied to Glaxo Laboratories Ltd., at Ulverston). Photo shows high level air supply duct in Freeze Drying Room.

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Check these points for yourself

This short check-list will help you to assess the merits of different types of electro-precipitators. Simon-Carves electro-precipitators rate a definite 'yes' to each of these vital questions. To assist you in making a full comparison, we will gladly send you our literature on the subject (*Please quote C.P.P/O*) and discuss your particular problem with you.

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7	Has the need for easy routine maintenance and inspection been taken into account at the design stage?	✓	?
8	Is the rectifier equipment robust, static, silent, shockproof and self-contained?	✓	?
9	Is the price comprehensive with no obscure 'exclusions' for essentials?	✓	?

HIGH EFFICIENCY ELECTRO-PRECIPITATION BY

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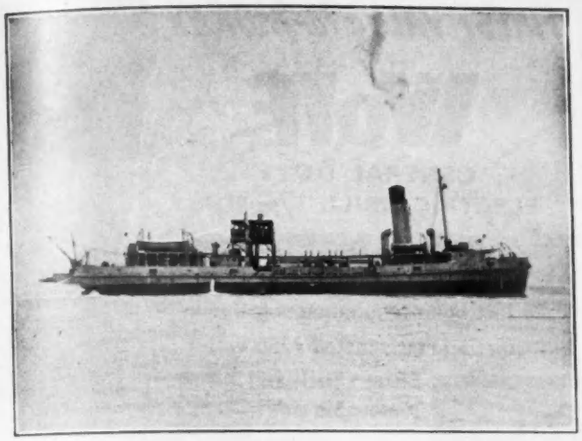

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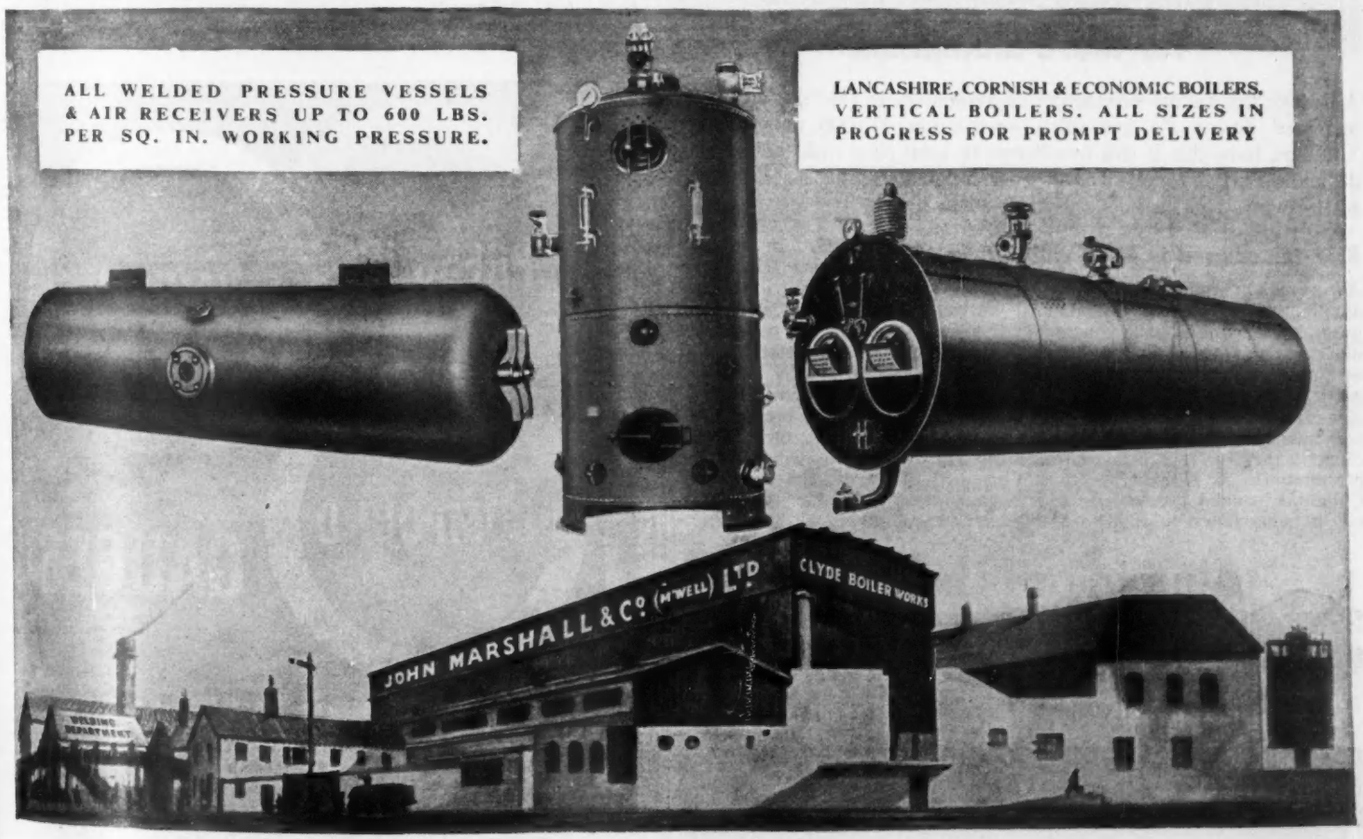
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C

At Kemano, the cavern in the mountain houses the vast generators supplying Kitimat with power. The panoramic view below shows a section of the Kitimat smelter.

Keeping pace with the demand for more aluminium

Although the annual production of aluminium in the free world has increased during the last thirty years from 210,000 tons to over 3 million tons, this is still insufficient to keep pace with the growing demand. Further large increases have become essential as established and new uses require more and more of the metal.

How the demand is being met

As a major producer of primary aluminium the Aluminium Limited group has responded to this increasing demand with a programme of continuous development in various parts of the world. In Canada, the new expansion programme in Quebec will increase the ingot producing capacity there to over 700,000 tons per annum. At Kitimat in British Columbia, annual productive capacity is being raised to 330,000 tons by the end of 1959. In Jamaica, production of alumina (aluminium oxide) is being increased to 543,000 yearly. In India, an aluminium smelter with an annual capacity of 20,000 tons is being established at Hirakud, Orissa.

Aluminium Union Limited distributes aluminium ingot produced by Aluminum Company of Canada, Ltd., in addition to exporting the products of the various fabricating companies within the Aluminium Limited group.

Aluminium Union Limited

(Incorporated in Canada)

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High power-weight ratio
Perfect balance eliminates fatigue
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High speed drilling in steel wheelbarrow production

BRIEF SPECIFICATION

Drilling capacity in Steel	½"
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Watts Input on full load	435 watts
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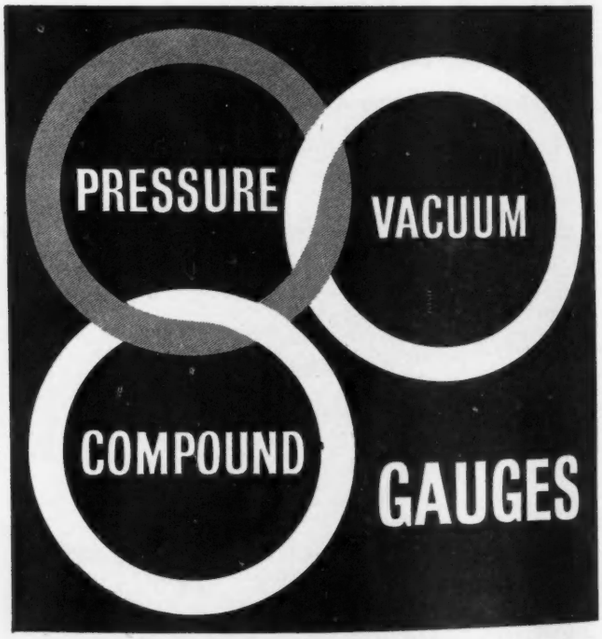

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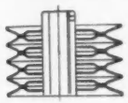
Rokvee

THE INDESTRUCTIBLE PULLEY



Rokvee pulleys are constructed by brazing together precision pressed steel plates giving light weight but immense strength. The joints are as strong as the steel itself.
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Therefore—to obtain the most efficient filtration be prepared to change the element more often.

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Registered Trade Marks: 'Purolator,' 'Micronic'

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up to 75 counts per second

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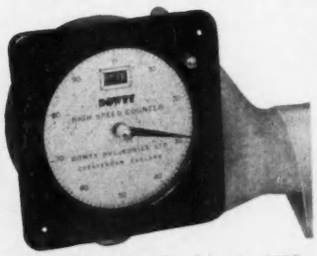

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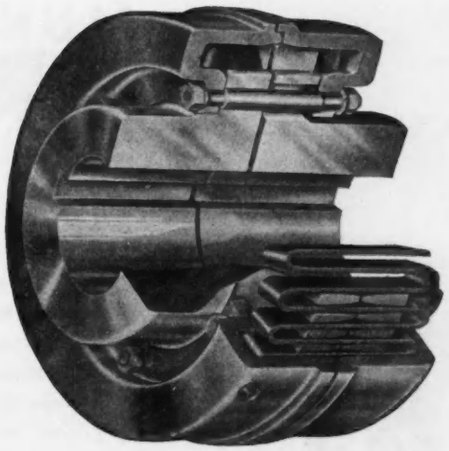

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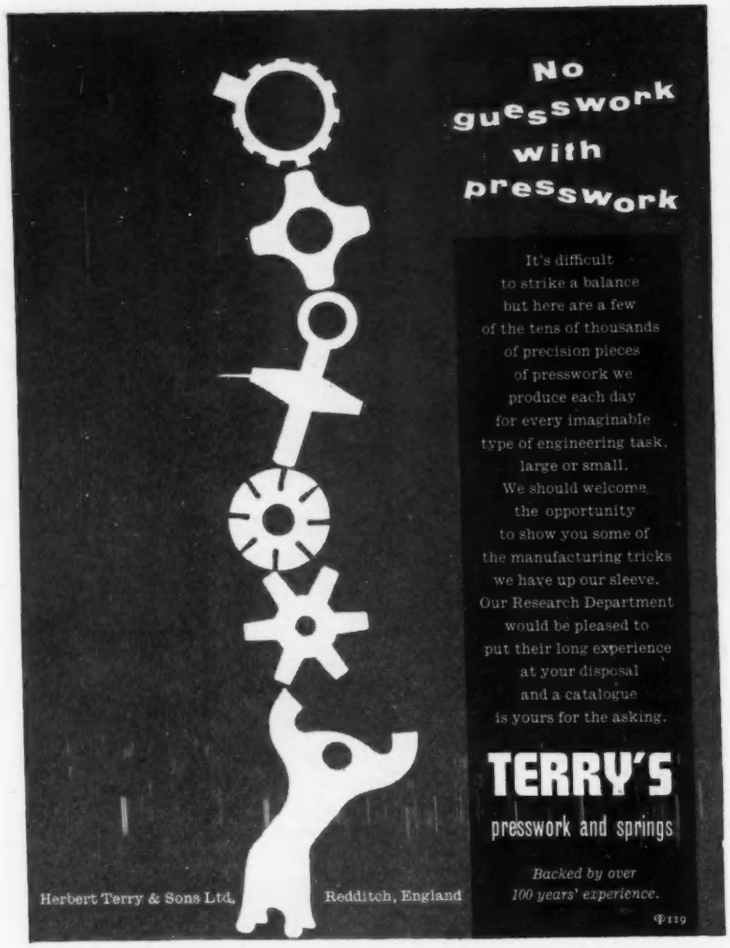
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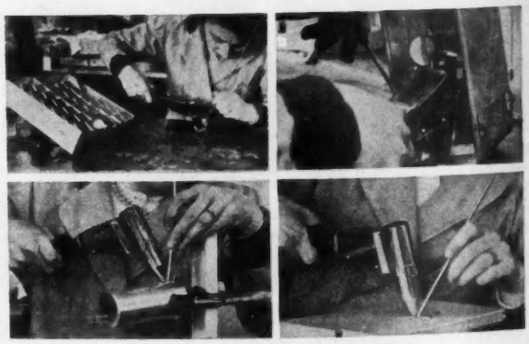

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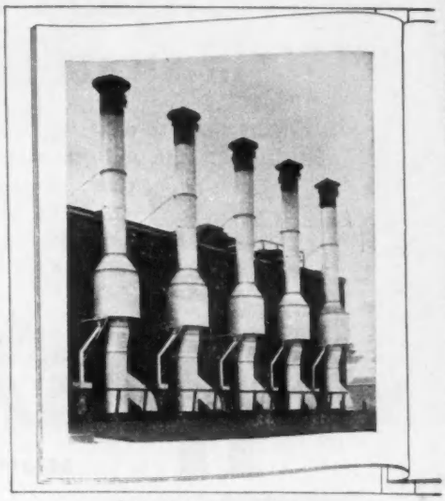

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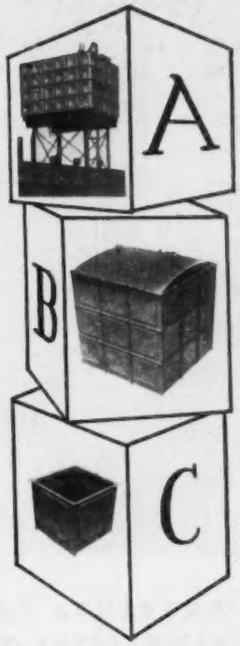
. . . building A, B, C bricks is the erection of a MECHANS Pressed Steel Tank



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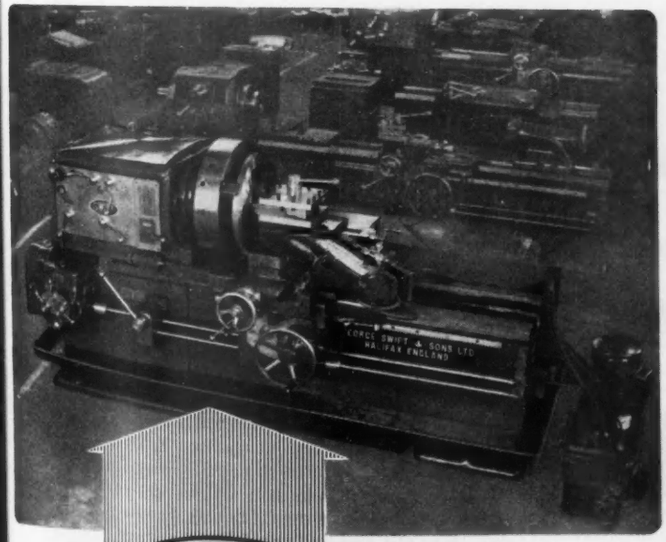

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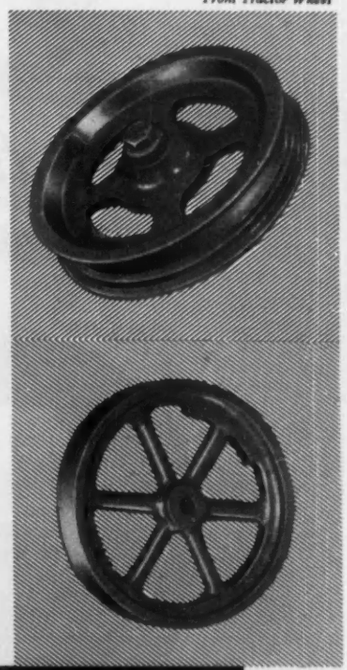

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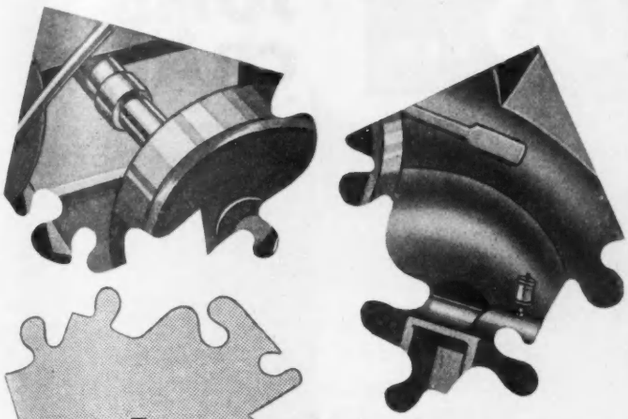

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The manufacturer with a production problem has a simple recourse . . . *contact Carron.* Innumerable firms who have not the resources or equipment to produce certain specific components for their products find that Carron can usually supply the missing part. For this huge company with its 130 acres of foundries, forging shops, machine shops, enamelling plant and sheet metal fabrication offers a complete service. Why not get in touch with Carron now? You may well save valuable time . . . and money.

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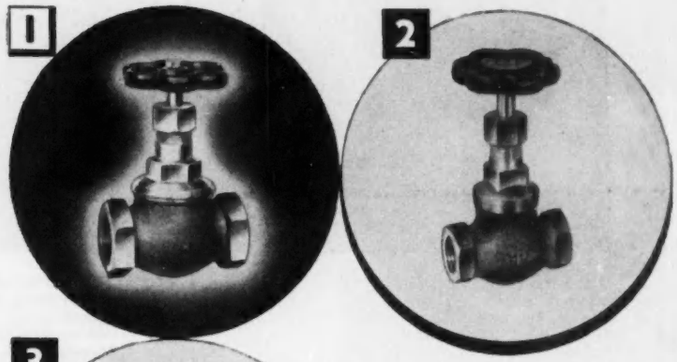

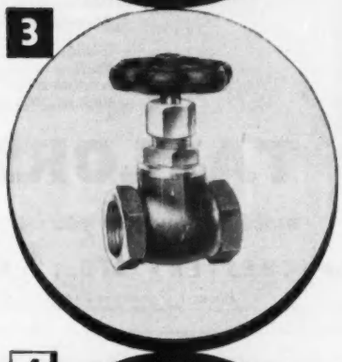

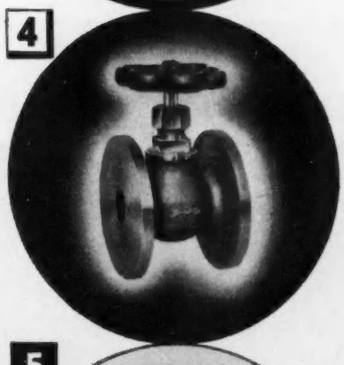

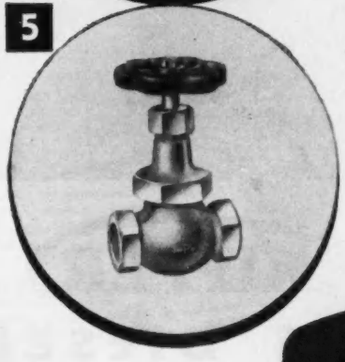

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Up to 200 lbs. saturated Steam ; 300 lbs. Water, non-shock 150°F. Button type valve. With valve fully open can be repacked under pressure. Sizes ¼"—2". No. 1029H. As No. 1032 but with renewable composition disc.

2 **No. 1031 (Gunmetal)**
Up to 150 lbs. saturated Steam ; 250 lbs. Water, non-shock 150°F. Metal-metal seating. Repackable under pressure with valve fully open. Sizes ¼"—4". No. 1029. As No. 1031 but with renewable composition disc. Sizes ¼"—3".

3 **No. 103X (Gunmetal)**
Up to 100 lbs. saturated Steam ; 200 lbs. Water, non-shock 150°F. Button type valve. Sizes ¼"—4".

4 **No. 1035 (Gunmetal)**
Flanged ends to B.S.T.E. Up to 150 lbs. saturated Steam ; 250 lbs. Water, non-shock 150°F.
No. 1029F as No. 1035 but with renewable composition disc.

5 **No. 1028B (Gunmetal)**
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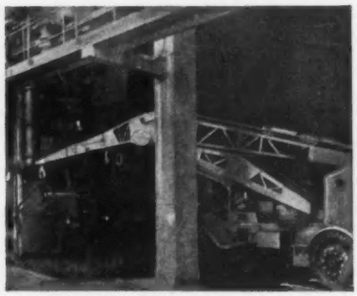

The 4-ton Jumbo Crane lifting a skip of ashes in the 25 cwt. position at Fulham Power Station. Headroom is only 11ft. 2in., so the jib extension, and not the main jib, is being used with unimpaired efficiency.

The Jumbo Junior lifting a railway truck chassis weighing approximately 30 cwt. at Associated Portland Cement Manufacturers, Greenhithe.

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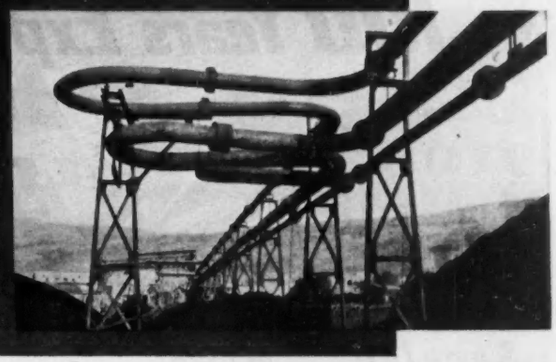

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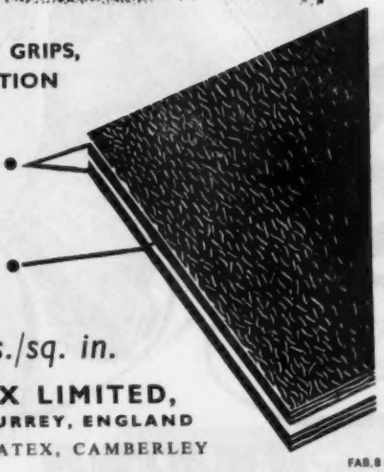
'Linatex' centre layer absorbs shock and vibration, gives smoother running, longer machine life.



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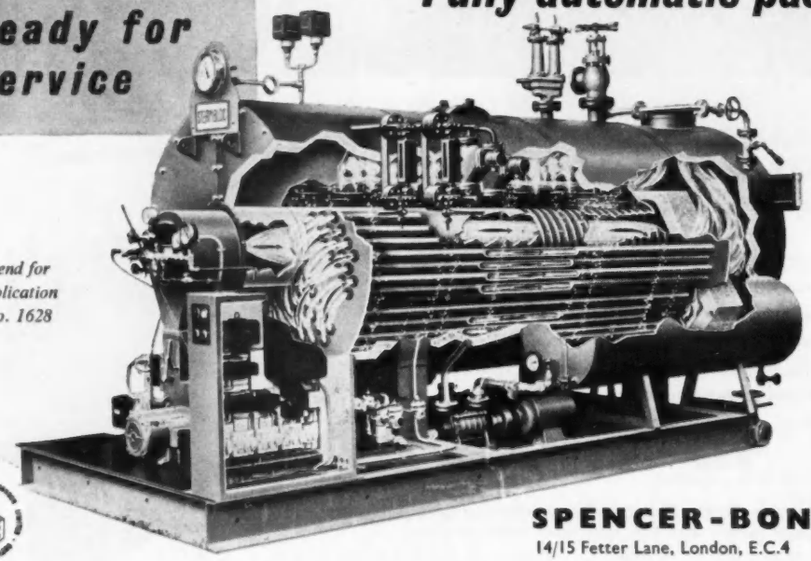

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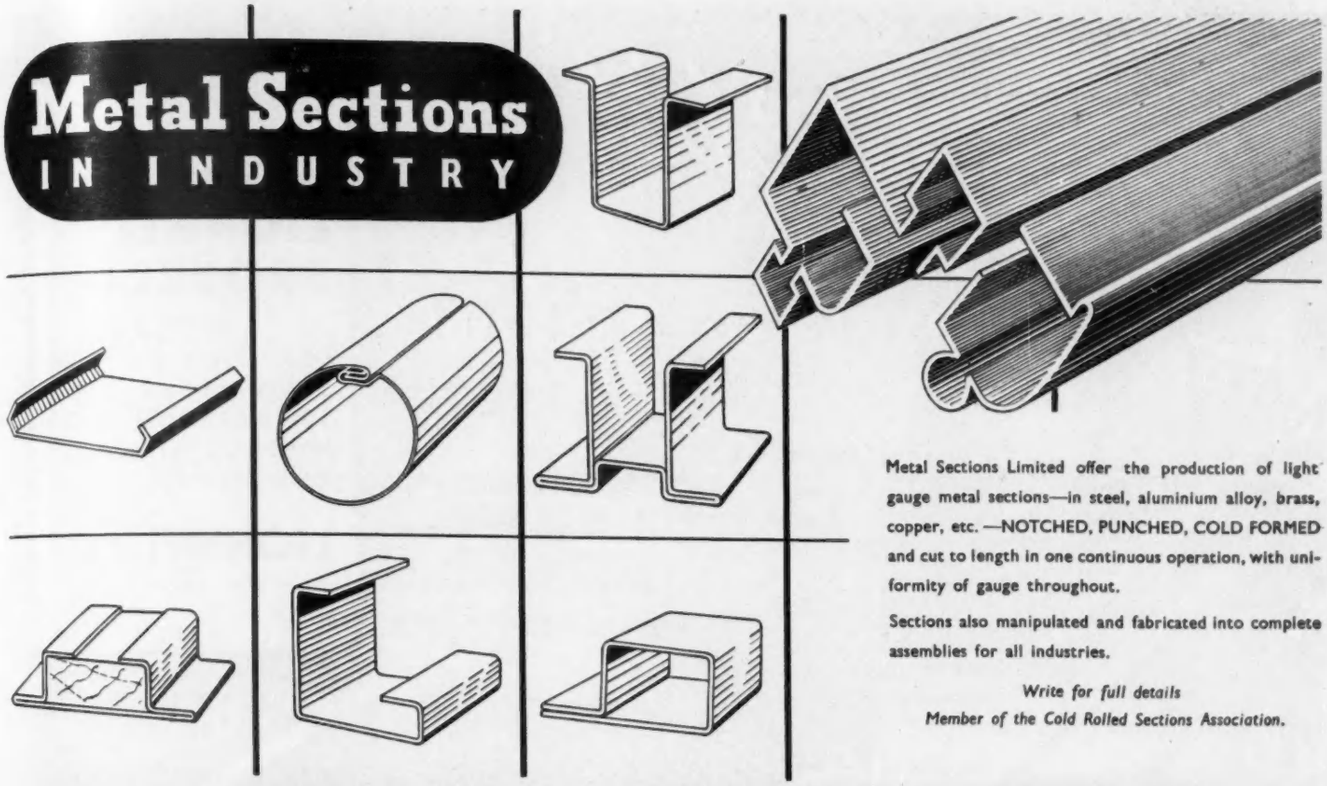

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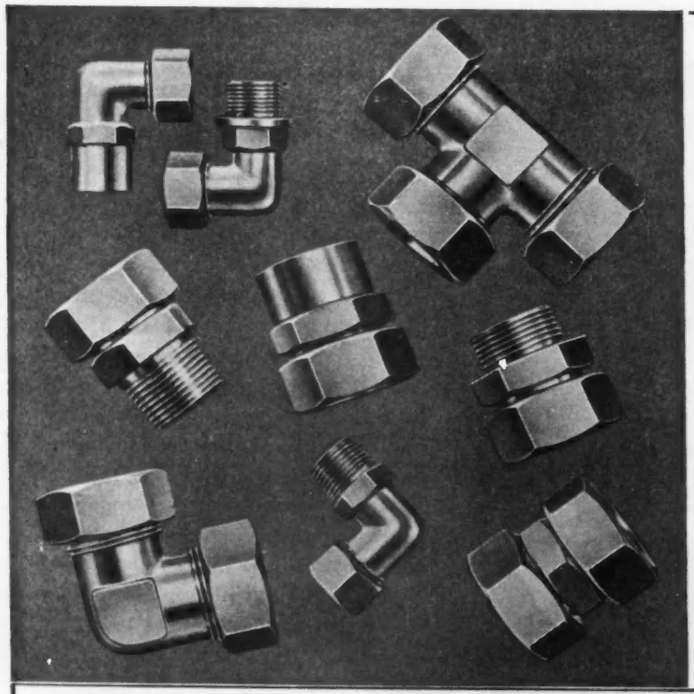

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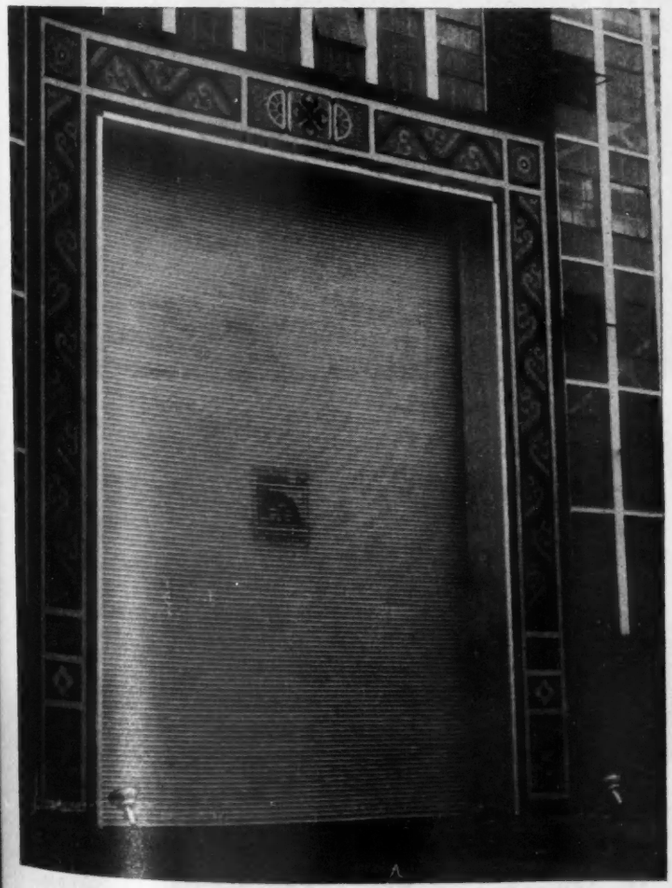

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2⅝" — 6 Cycle times 7·1—922 secs.
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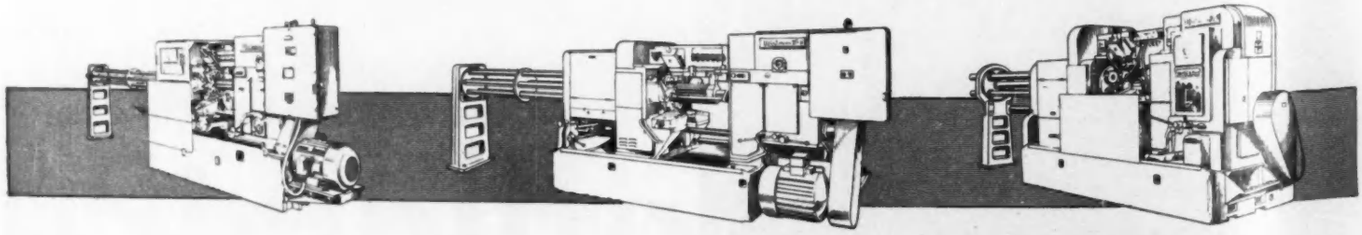

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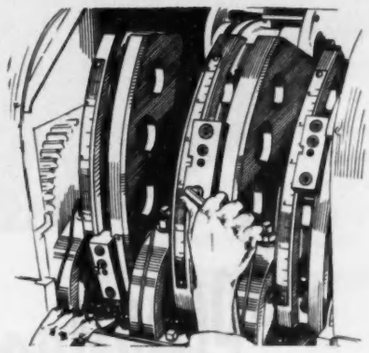

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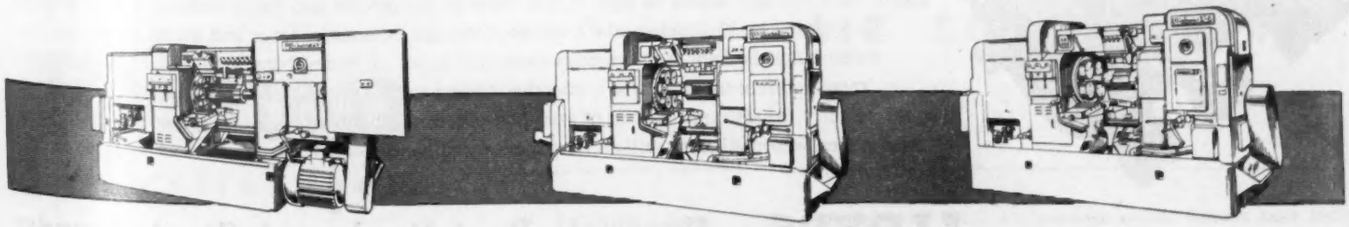

6⅝″ — 6	Cycle times	10·6—1297 secs.	7¼″ — 6	Cycle times	10·9—1408 secs.	9″ — 4	Cycle times	17·7—1968 secs.
	Spindle speeds	78—1302 r.p.m.		Spindle speeds	77—1004 r.p.m.		Spindle speeds	43—554 r.p.m.

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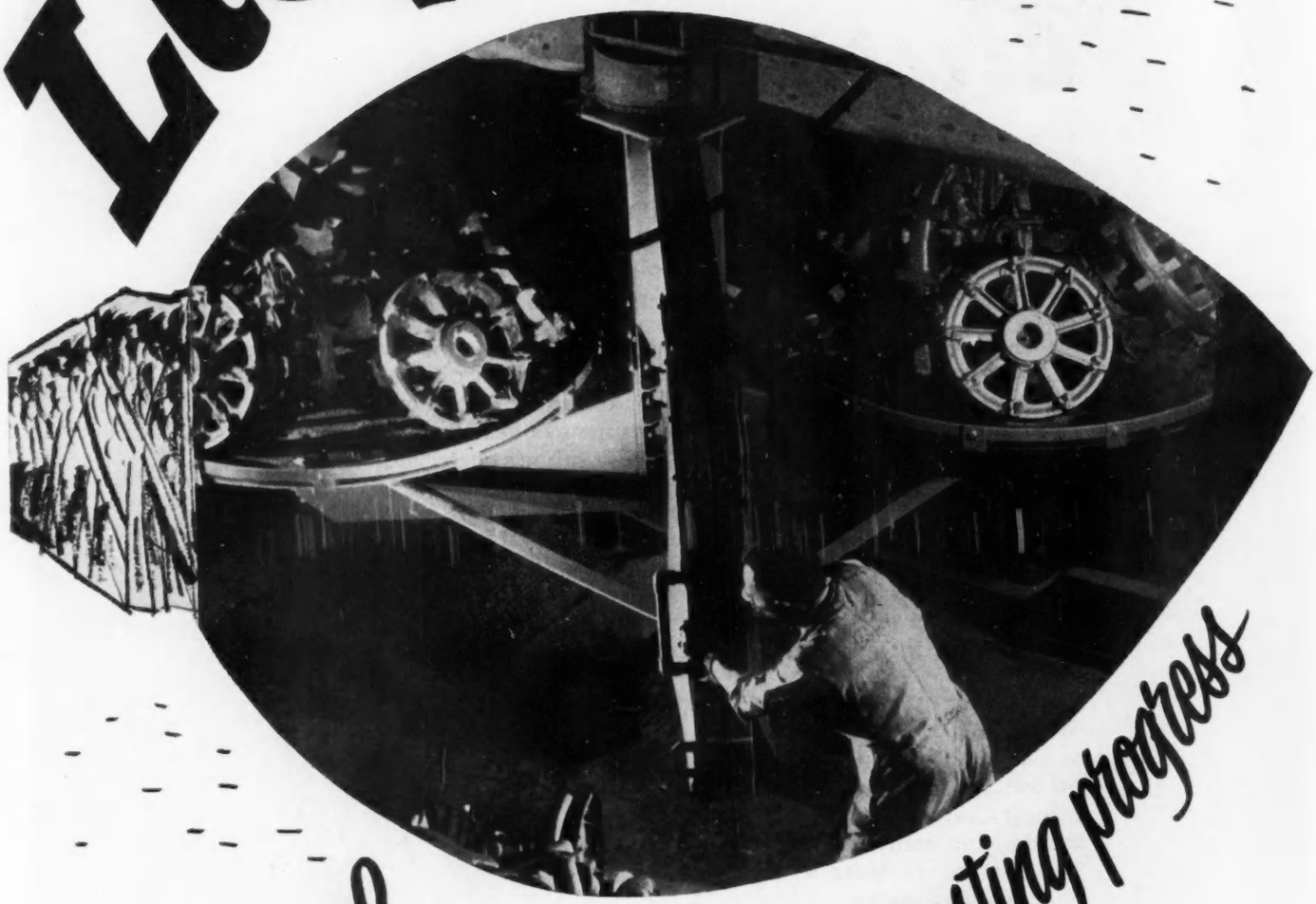
Lloyds



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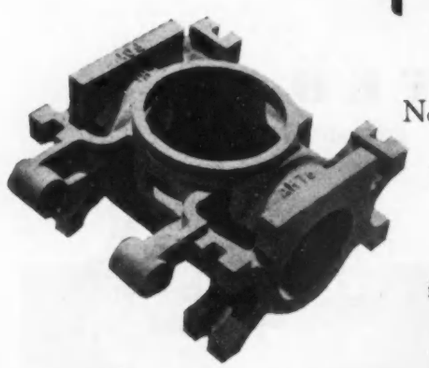

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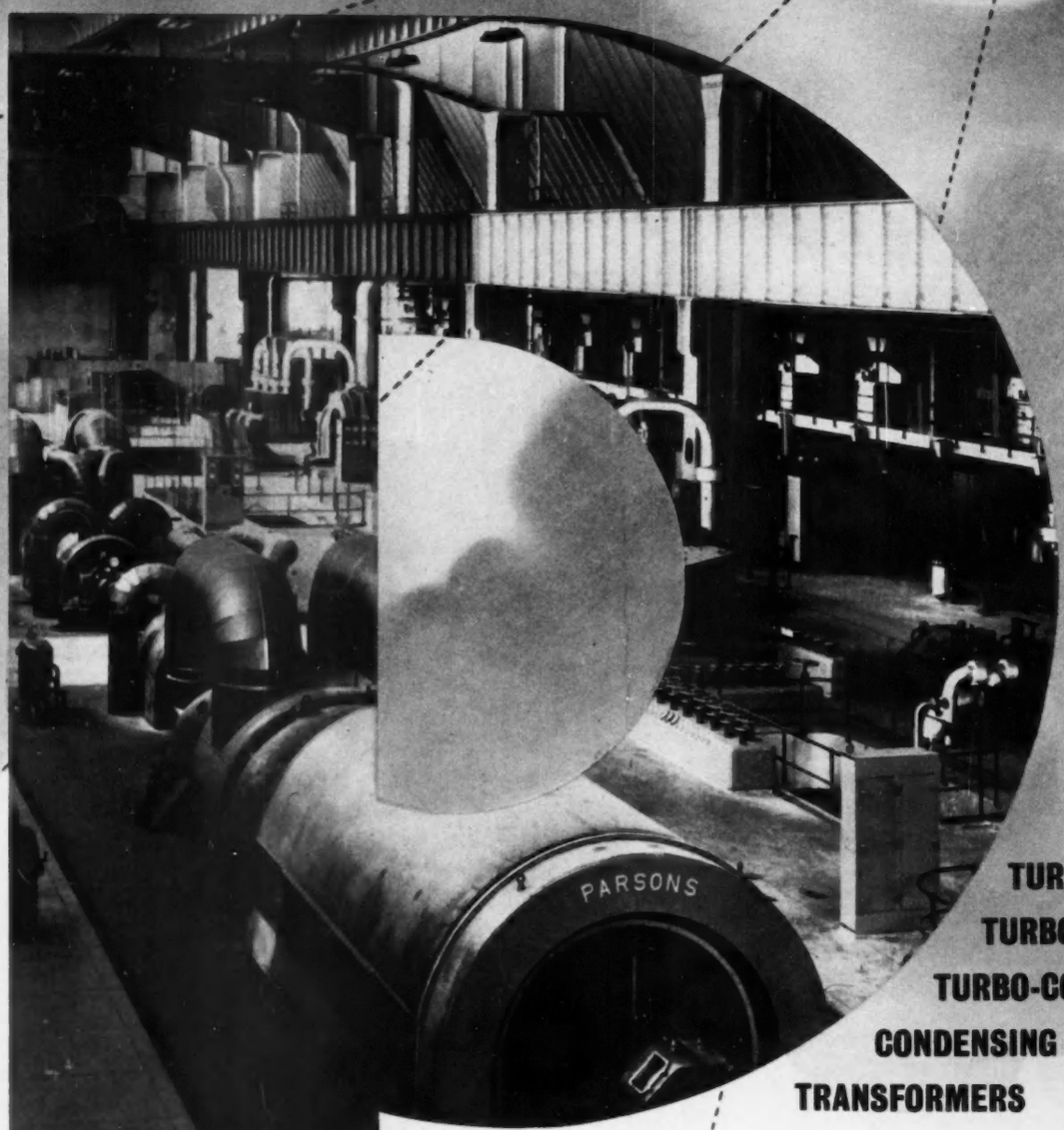

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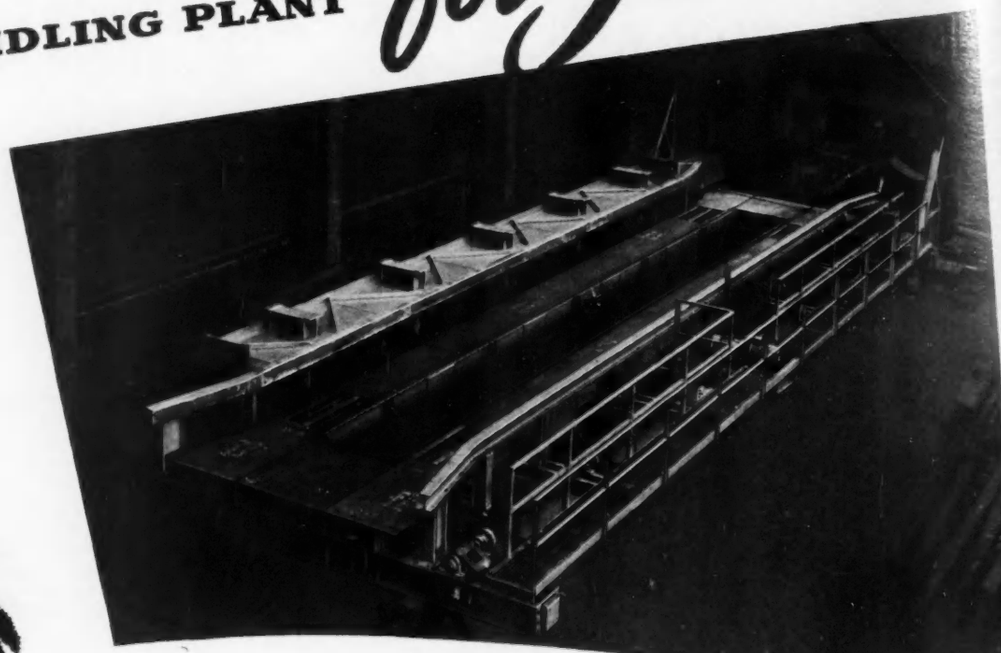

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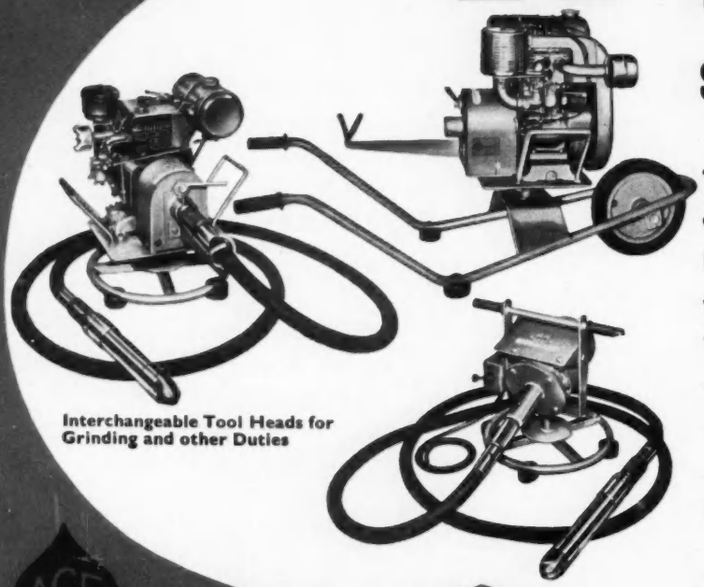

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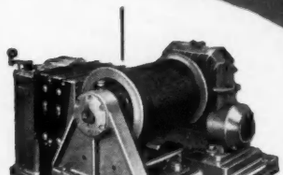

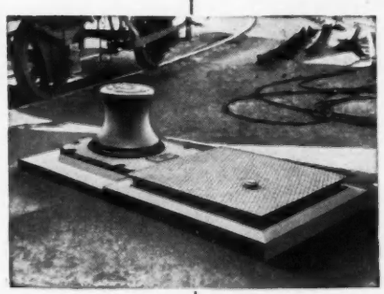

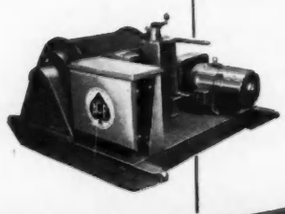

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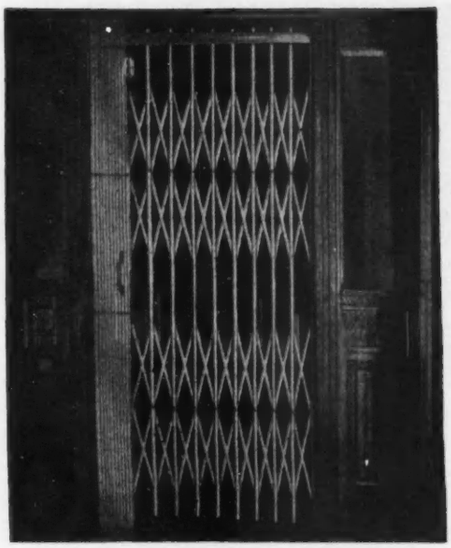
G.29

G

"Duralumin" Swinging Gates at J. Lyons' factory, Greenford. *This handsome pair of 16-ft. gates open at a touch and their light weight relieves strain on the hinges. They need no painting and can be kept in first-class condition with minimum maintenance. (Courtesy : J. Lyons & Co. Ltd., and Duramin Engineering Co. Ltd.)*



"Duralumin" Lift Gate at Vickers-Armstrongs Ltd., Barrow. *To reduce weight on the operating gear these light-weight lift gates were installed in 1913. They are free from rust, move with ease and save the operator effort. (Courtesy : Vickers-Armstrongs Ltd.)*

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"Duralumin" Portcullis Gates at Tunnel Cement Works, West Thurrock. *The use of "Duralumin" for these factory gates saves weight, and therefore time and power. They are electrically operated and go up and down in a flash. They need no painting and there is no danger of corrosion. (Courtesy : Tunnel Cement and Duramin Engineering Co. Ltd.)*

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behind the steel casting

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three... two... one... **FIRE!**

To a lively imagination—influenced, perhaps, by current "space-fiction" programmes—this might be an illustration of an anti-Martian Mortar being fired by space-men. It is in reality an 18in. by 12in. by 10in. Y piece for circulating water piping in a Boiler by Mitchell Engineering Ltd. operating at 1,150 lbs./sq. in. and 588 deg. F. for the Portishead "B" Generating Station. Designed, fabricated and tested by the BRISTOL PIPING CO. LTD.

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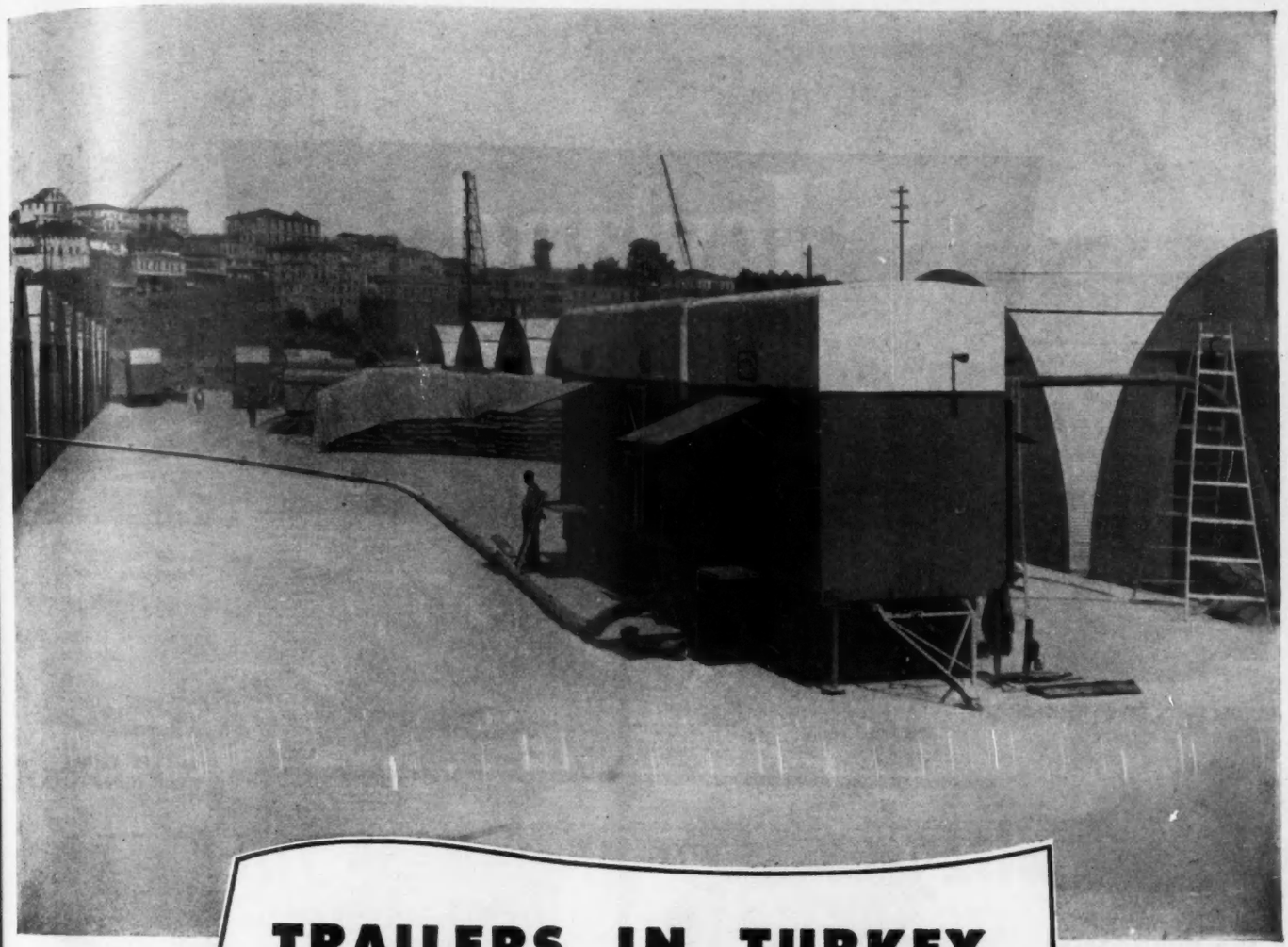

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These Simon units are working in Turkey. We supplied twenty-four trailer-mounted installations of this type three years ago to deal with an expanding grain production. Since that time they have handled millions of tons pneumatically. The trailers speed the turn-round of ships and relieve pressure at ports whilst Turkey awaits the completion of Simon grain silos. Bulk grain is discharged over distances of more than 200 feet. By providing temporary means of exporting a basic commodity the trailers make an important contribution to Turkish economy.

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AVELING-AUSTIN 99-H MOTOR GRADER

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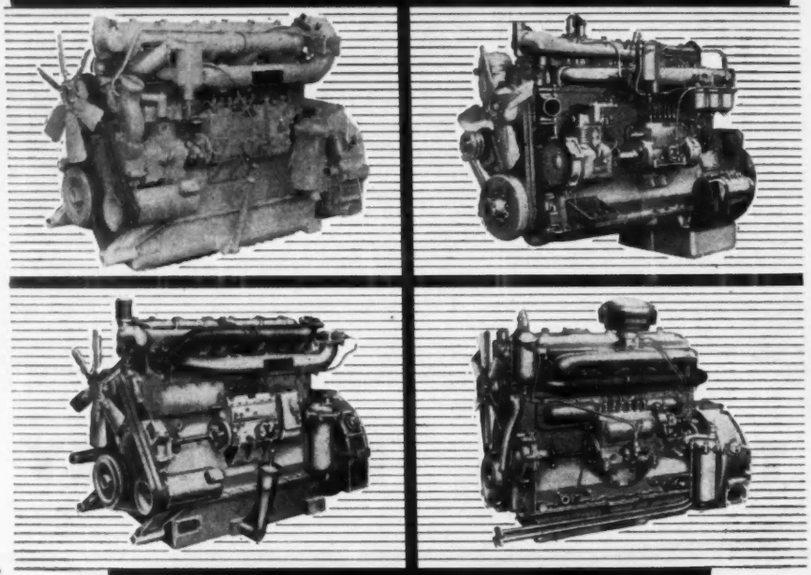

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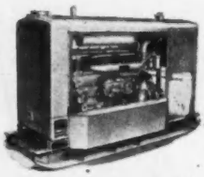

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BLAW-KNOX BK-12 MOTOR GRADER.

MODEL	BORE	STROKE	SWEPT VOLUME	WEIGHT (DRY)	RATINGS (BS.649—1949 AT N.T. & P.)		
					1 hour or less	12 hours or less	Day and night
350 Vertical or Horizontal	3.96 in. (100.6 mm.)	4.75 in. (120.7 mm.)	351 cu. in. (5.75 litres)	1,178 lb. (545 Kg.)	91 b.h.p. at 2,200 r.p.m	78 b.h.p. at 2,000 r.p.m.	64 b.h.p. at 1,800 r.p.m.
600 Vertical or Horizontal	4.8 in. (121.92 mm.)	5.5 in. (139.7 mm.)	597 cu. in. (9.8 litres)	1,625 lb. (738 Kg.)	125 b.h.p. at 1,800 r.p.m.	112.5 b.h.p. at 1,800 r.p.m.	92 b.h.p. at 1,600 r.p.m.
680 Vertical or Horizontal	5 in. (127 mm.)	5.75 in. (146 mm.)	677 cu. in. (11.1 litres)	1,640 lb. (744.5 Kg.)	150 b.h.p. at 2,000 r.p.m.	135 b.h.p. at 2,000 r.p.m.	115 b.h.p. at 1,800 r.p.m.
900 Vertical or Horizontal	5.5 in. (139.7 mm.	6.5 (165.1 mm.)	927 cu. in. (15.2 litres)	2,580 lb. (1170.2 Kg.)	200 b.h.p. at 1,840 r.p.m.	170 b.h.p. at 1,800 r.p.m.	142 b.h.p. at 1,600 r.p.m.

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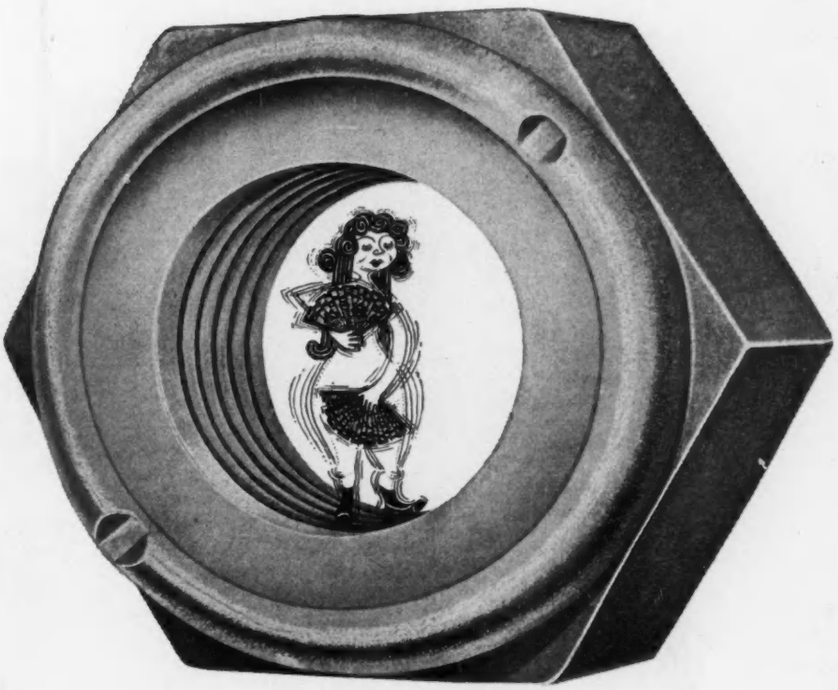
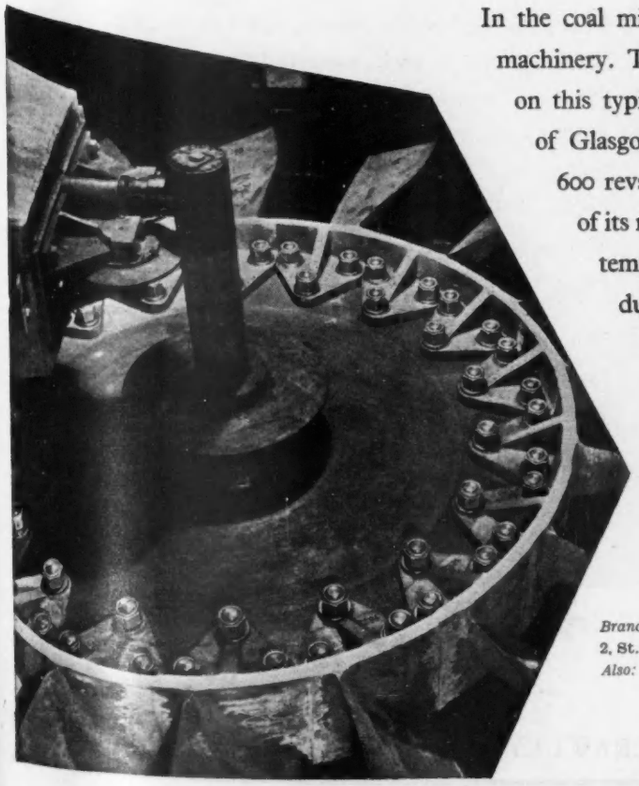


. . . but nothing moves the NYLOC



In the coal mining industry there's a mortal need for dependable ventilation machinery. That's a good reason why there are 54 Nyloc self-locking nuts on this typical rotor of a mine fan installation built by Thermotank Ltd., of Glasgow. Nylocs secure the blades which spin continuously at nearly 600 revs a minute. A Nyloc nut, with its nylon insert, will never let go of its responsibility, not even in the face of recurring tensions, vibrations, temperature changes or electrical impulses. It will hold firm even during immersion in oily liquids. Each nut to its own job! We also make Fibre Nuts (with fibre insert) and Pinnacle Nuts (with metal diaphragm).

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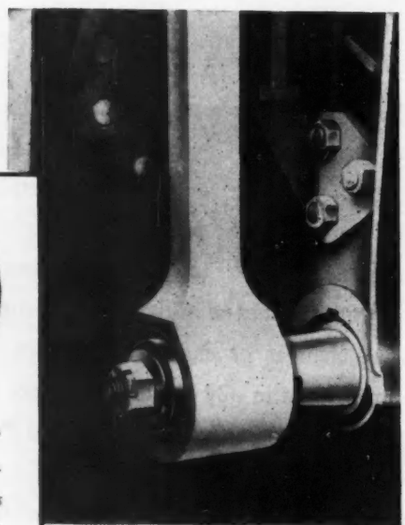
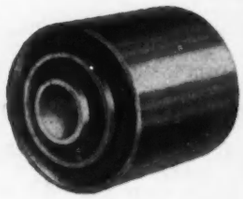
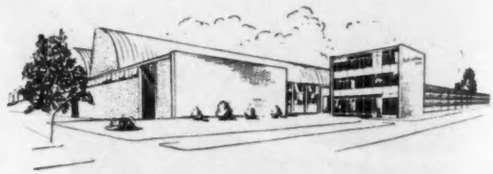
You will doubtless find in the range of over 400 types the perfect Silentbloc Bearing for your purpose. If not, we shall be pleased to create a special design for you.



Metropolitan-Vickers Swing Link Suspension showing the Silentbloc "Duplex" bearing in the lower end of the link



The Silentbloc "Duplex" bearing — a Silentbloc within a Silentbloc. It provides double the angular movement permissible in a single unit



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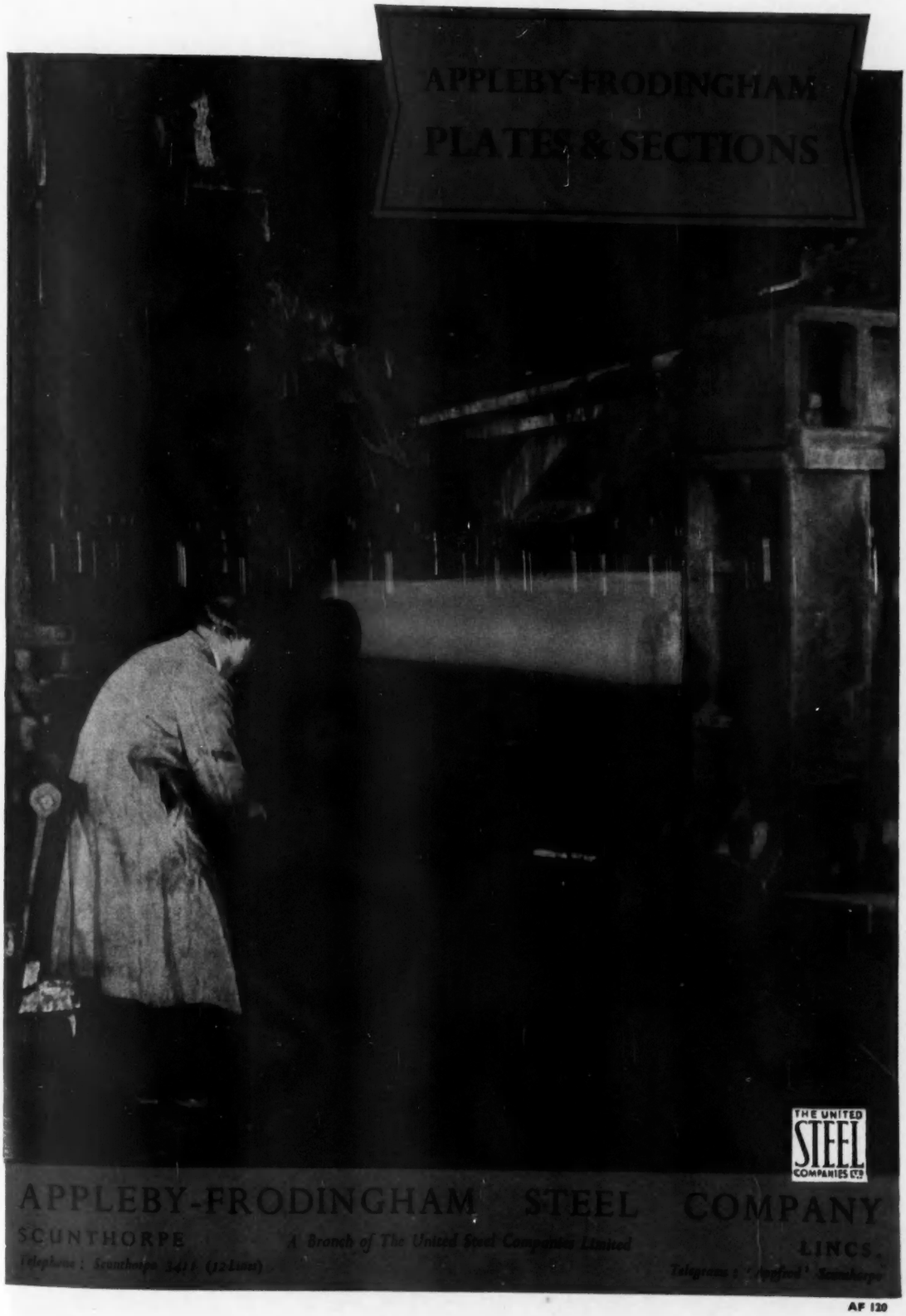
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Chief Inspector

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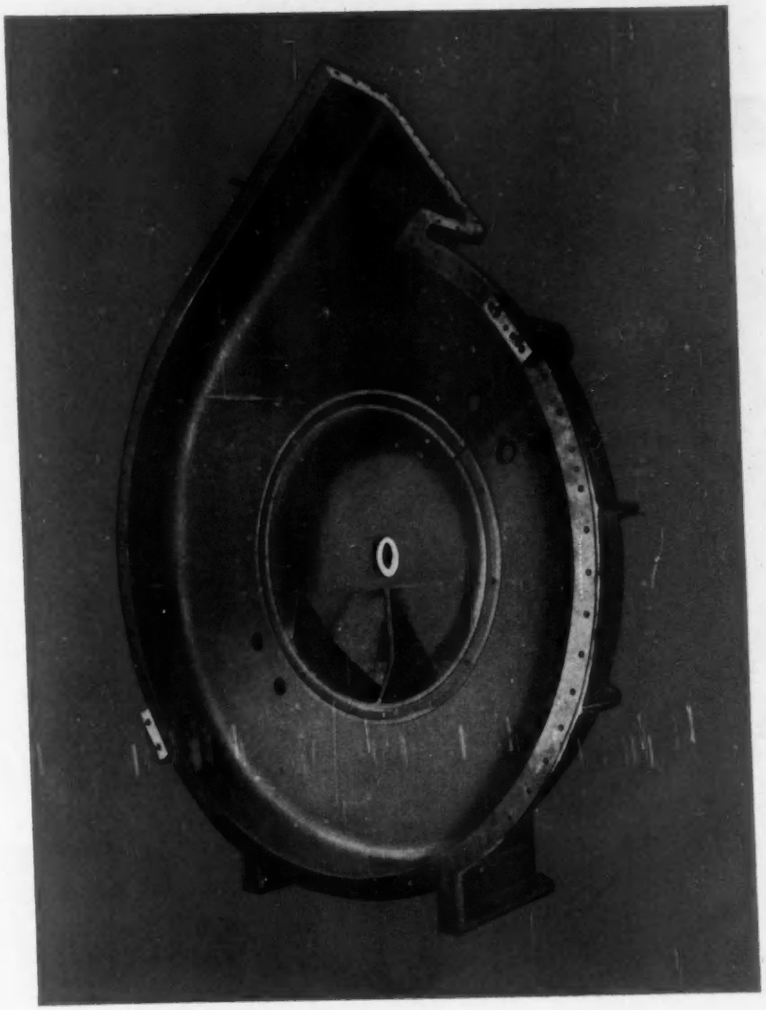
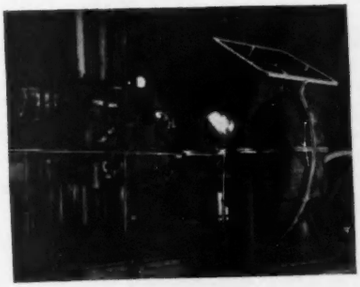
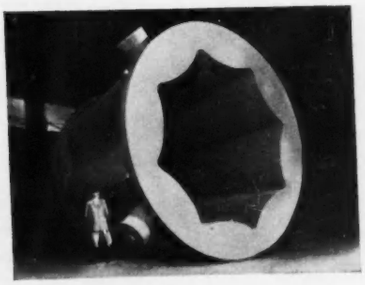


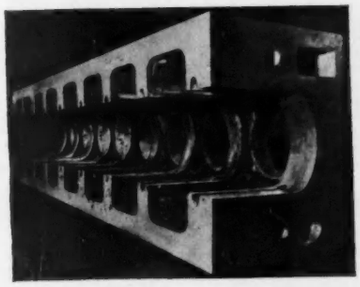
SPORTING AND FOUNDRY LIFE

In the half of the fan casing (above) our hound Rollover could find only one blow hole—the flanged aperture at the top. (Right) we see the same casting with its mate in one of our machine shops. The machine operator, moleskin waistcoat type, cannot be told anything about horizontal boring. He won't lay a bead on a hare unless it's on the beam, 100 yards min., small bore ammo, gale warning cones hoisted. To him, a micrometer is as crude an instrument as a wagon weighbridge is to an analytical chemist.





Our own analytical chemists watch the quality of our West Coast Hematite iron like hawks. Not a pip too much of sulphur, not a trace of harmful residual elements to cause premature cracking, or the metal would be doomed to be used for making door stops. We make castings in grey iron and special irons. We machine them. We relieve the stresses in them. The stresses in ourselves are relieved by the heat of the chase.



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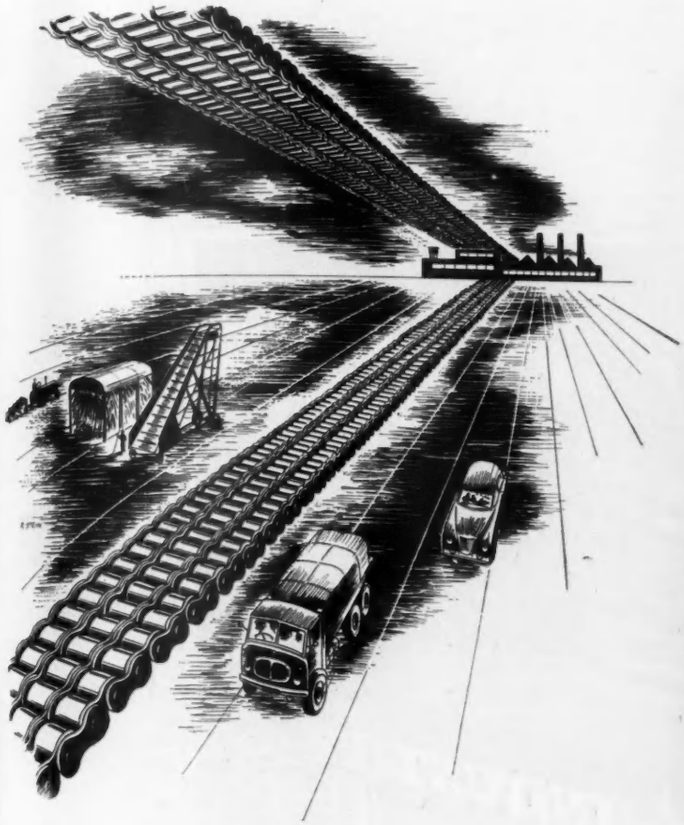
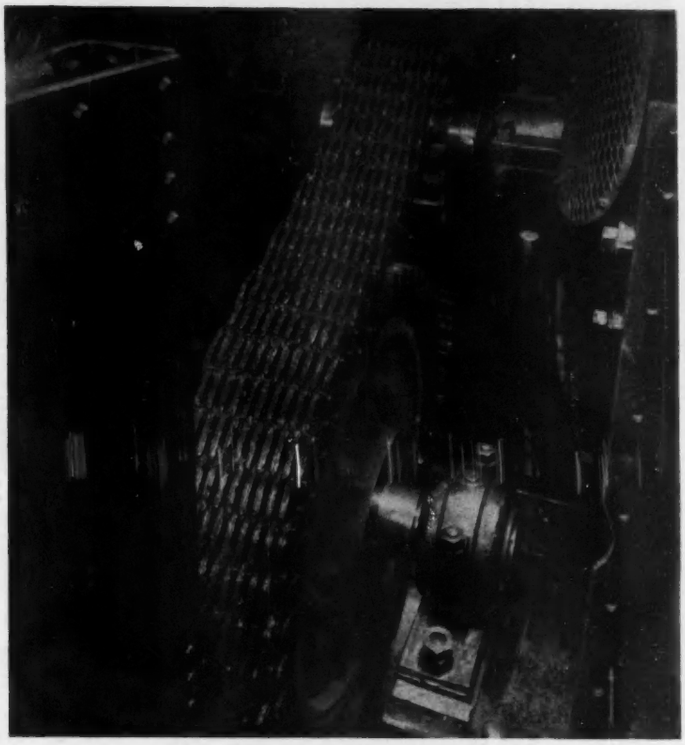


In the long run it pays to install MORSE chains



Picture by courtesy of Southern Region B.T.C.

In 1912 a Morse 70 h.p. Inverted Tooth Type 2in. pitch 7in. wide Chain drive was installed at the Brighton Depot of the London, Brighton and South Coast Railway to drive a deep well pump. This drive has been in constant use since that time and is still giving the same trouble-free service as it did in 1912.

CONSTANT research, long experience, the highest standards of manufacture and inspection ensure that Morse Chains give the trouble-free service with a minimum of maintenance which is essential to the efficient and economic running of industrial plant. For over fifty years, engineers have been specifying Morse Chains with the knowledge that, although designs may change, the built-in quality never varies.

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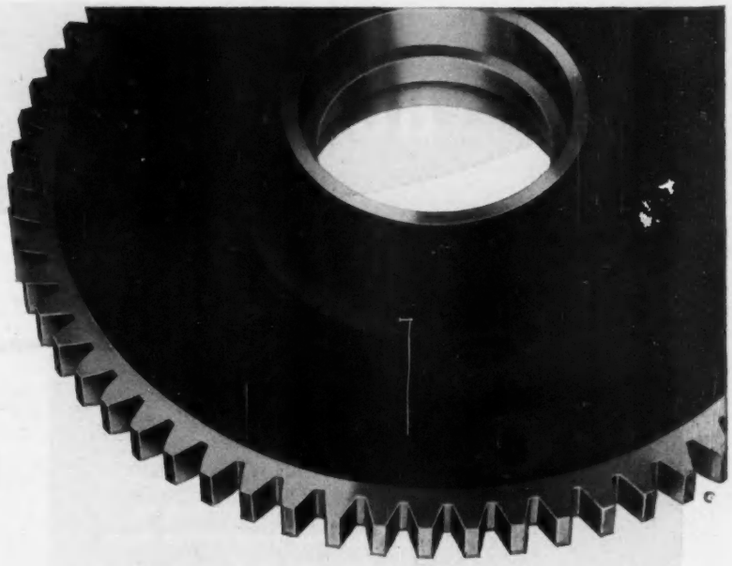

where the

wheels of industry

run smoothly

efficiently and silently

there are

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GIVES YOU THESE 6 ADVANTAGES

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2 LOW INSTALLATION COSTS

The advantages of concrete construction are carried into furnace building. Refractory concrete completely eliminates tedious and expensive grinding and facing of bricks.

3 FLEXIBILITY OF DESIGN

Concrete construction techniques can be easily adapted to meet your particular design requirements. Monolithic construction eliminates leaky joints and new design fields are opened to the Engineer. *REMEMBER*—Simplification means lower initial cost and cheaper maintenance.

4 RESISTANCE TO COMBUSTION GASES

The well known corrosion-resisting properties of Ciment Fondu are accentuated when it is incorporated into refractory concrete. This fact—coupled with the gas-tightness of monolithic construction—gives maximum protection for steel shells and supports.

5 AVOIDANCE OF DELAY

By keeping a few bags of Ciment Fondu or a proprietary castable mix in your works, you have complete insurance against costly delays. In the case of small repairs a proprietary castable mix is more convenient. There are many reputable manufacturers throughout the country who will be pleased to supply you with a complete range of refractory and insulating concrete mixes.

6 INSULATION WITHOUT EXTRA COST

Refractory concrete has a lower conductivity than its firebrick counterpart—9″ of refractory concrete has greater insulation value than 12″ of firebrick. Composite units of refractory and insulating concretes can be cast without fear of subsequent separation. *REMEMBER*—a wide range of available aggregates can give you a great range of insulation values, thereby making this material *one of the most versatile refractories known.*

TECHNICAL LITERATURE DEALING WITH SPECIFIC USES OF REFRACTORY CONCRETE IS AVAILABLE ON REQUEST
YOUR ENQUIRIES ARE INVITED AND WILL BE DEALT WITH IMMEDIATELY

* *Refractory Concrete is a mixture of CIMENT FONDU and crushed refractory aggregates*

CIMENT FONDU
Regd Trade Mark
ALUMINOUS CEMENT

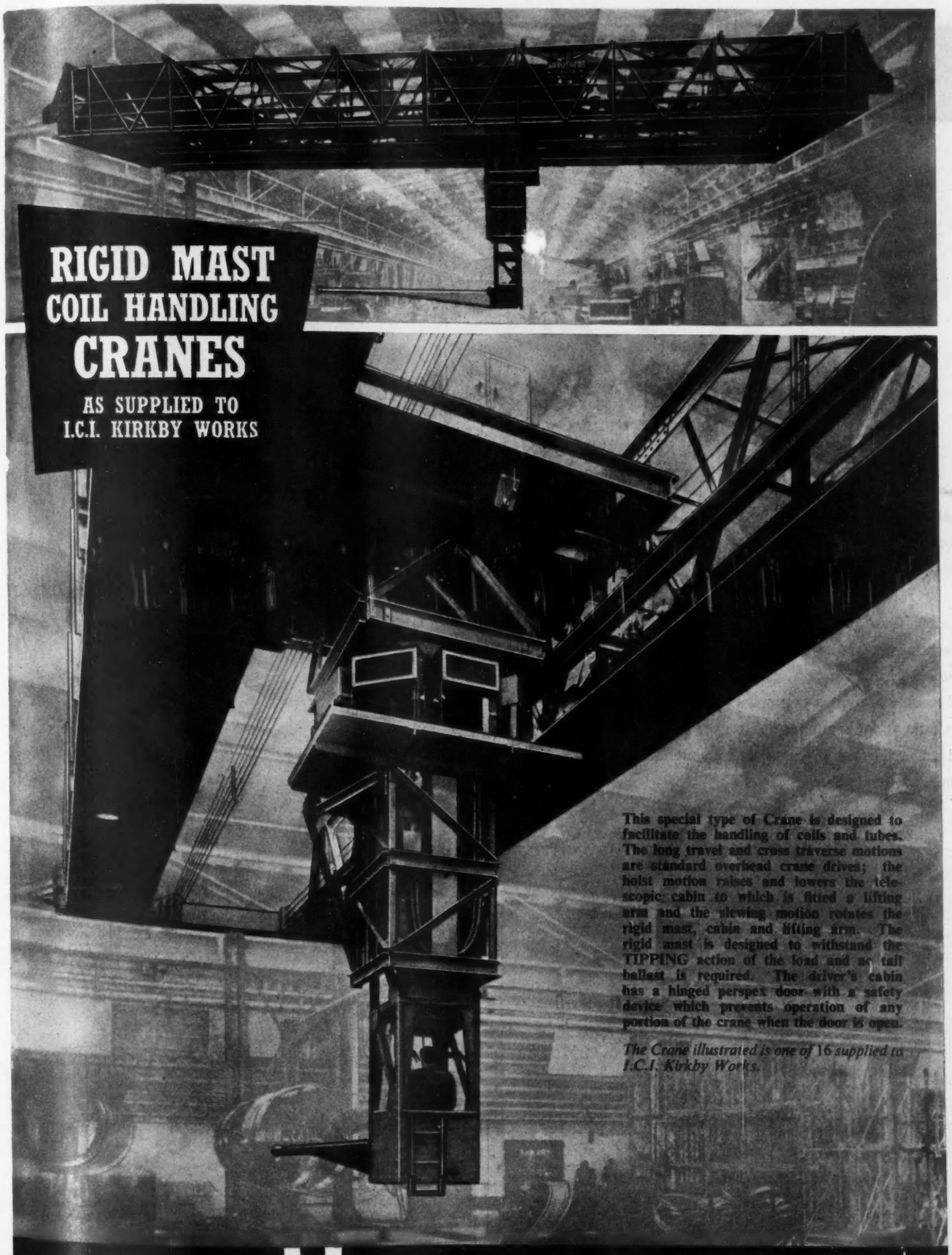
† *A list of suppliers of crushed refractory and insulating aggregates, and of manufacturers of proprietary castable mixes is available on request*

Manufactured by

LAFARGE ALUMINOUS CEMENT COMPANY LIMITED

73 BROOK STREET, LONDON W.1 TELEPHONE: MAYFAIR 8546

AP3/1266



RIGID MAST COIL HANDLING CRANES

AS SUPPLIED TO I.C.I. KIRKBY WORKS

This special type of Crane is designed to facilitate the handling of coils and tubes. The long travel and cross traverse motions are standard overhead crane drives; the hoist motion raises and lowers the telescopic cabin to which is fitted a lifting arm and the slewing motion rotates the rigid mast, cabin and lifting arm. The rigid mast is designed to withstand the TIPPING action of the load and no tail ballast is required. The driver's cabin has a hinged perspex door with a safety device which prevents operation of any portion of the crane when the door is open.

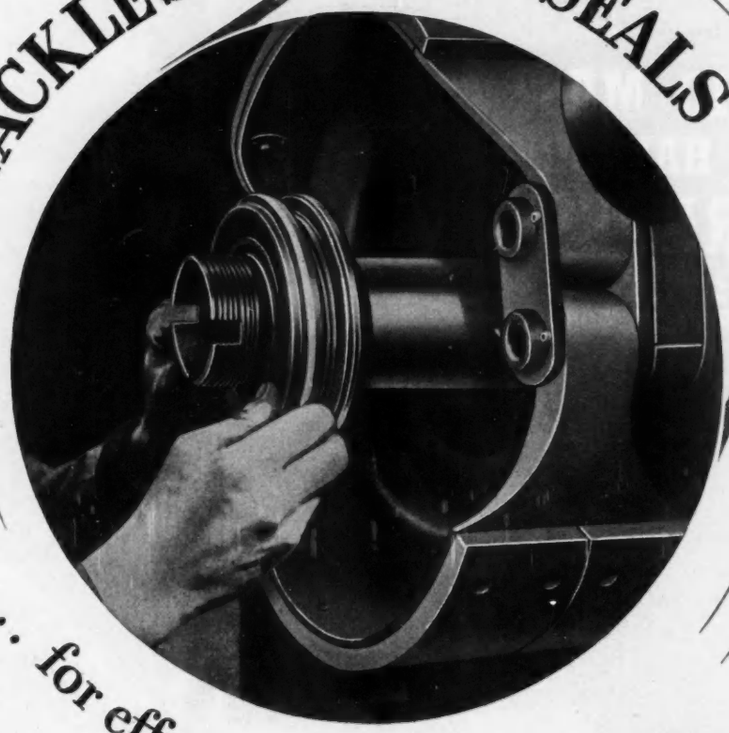
The Crane illustrated is one of 16 supplied to I.C.I. Kirkby Works.

carruthers' cranes

J. H. CARRUTHERS & CO. LTD., GLASGOW, S.2. • London Office: Abford House, Wilton Road, Victoria, S.W.1

Teddington

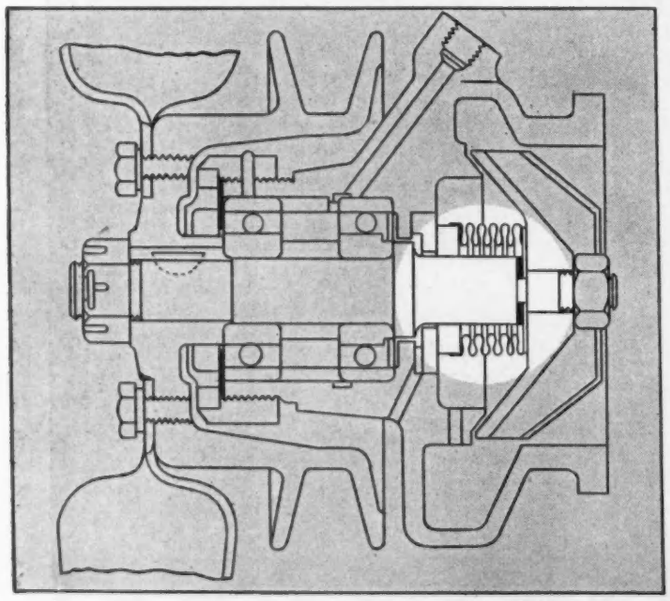
PACKLESS SHAFT SEALS



Photograph by courtesy of London Transport Executive

... for effective sealing against most liquids and gases

TEDDINGTON Shaft Seals are ideal for shafts running at speed. For example a 3½" dia. shaft running at 2000 R.P.M. in temperatures up to 300°F is quite normal. As peripheral speed of the rubbing surfaces is the deciding factor, they can be fitted to larger shafts running at lower speeds, or to smaller ones at high speeds. They will retain most liquids or vapours at pressures from 30-in. vacuum to 250 lbs. per sq. in., and are unaffected by continuous or intermittent running, or reversing.



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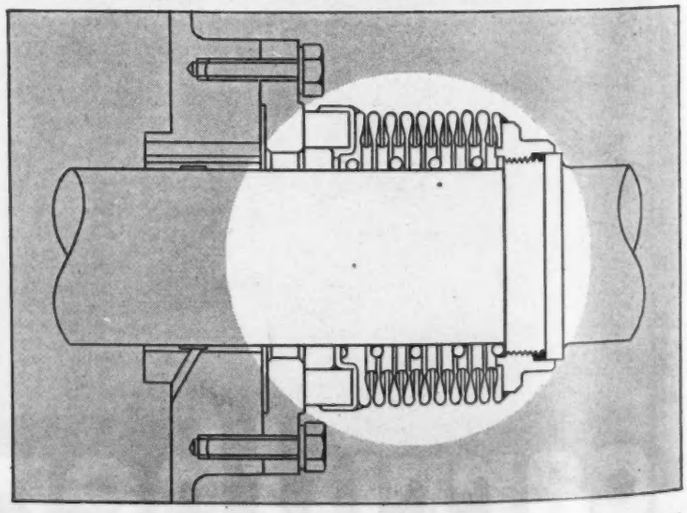
The British Thermostat Company are the largest manufacturers of metallic bellows in Europe and, during the last 25 years, have acquired unique experience in the design and application of metallic bellows and packless shaft seals. Write for Leaflets NS.5 and NS.33.

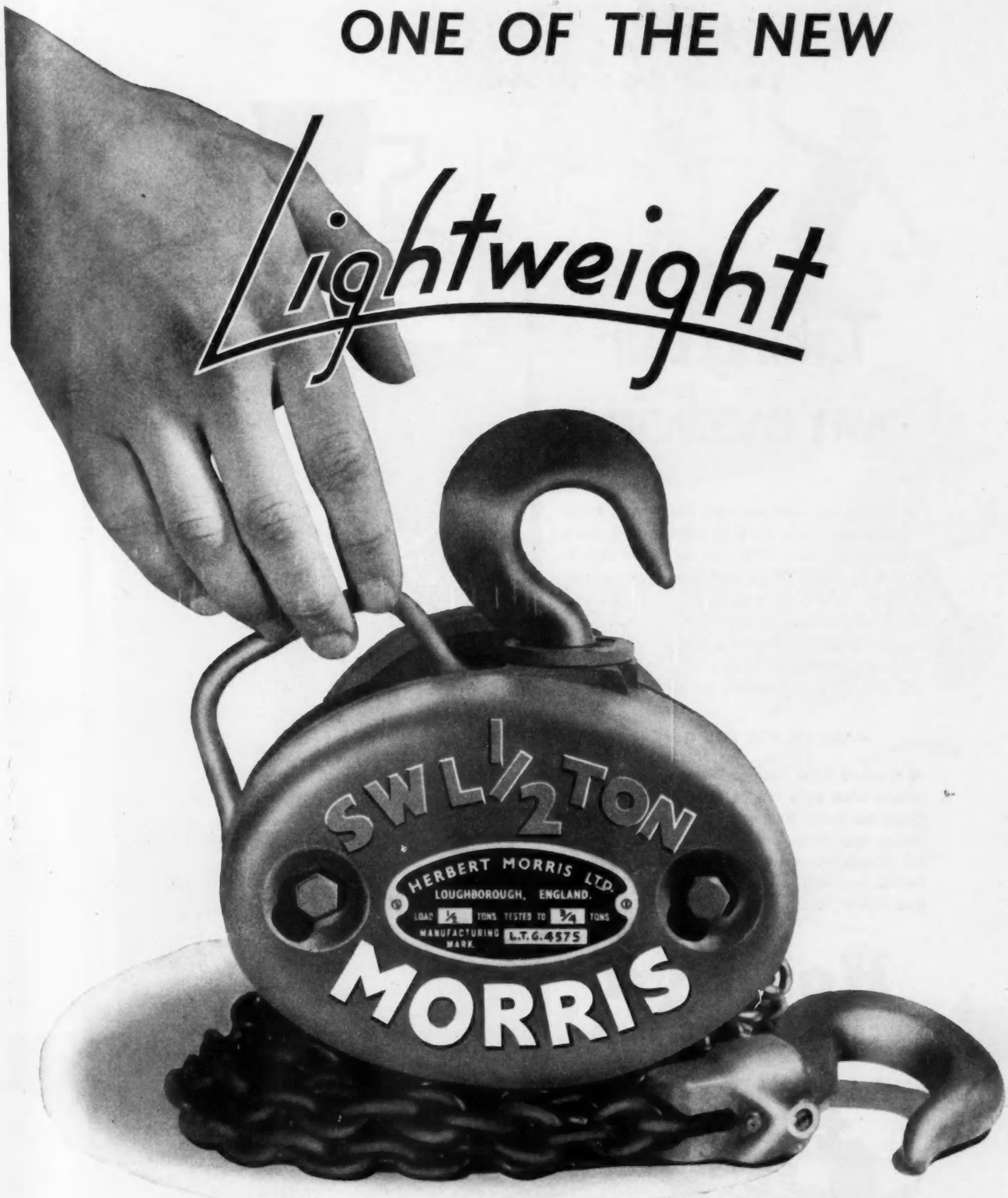


THE BRITISH THERMOSTAT CO. LTD., SUNBURY-ON-THAMES, MIDDLESEX. *Telephone: Sunbury-on-Thames 456*

Telegrams & Cables: THERMOSTAT, SUNBURY-ON-THAMES, TELEX Telex: 2-2742 TEDDCONTSNBRY

ONE OF THE NEW

Lightweight



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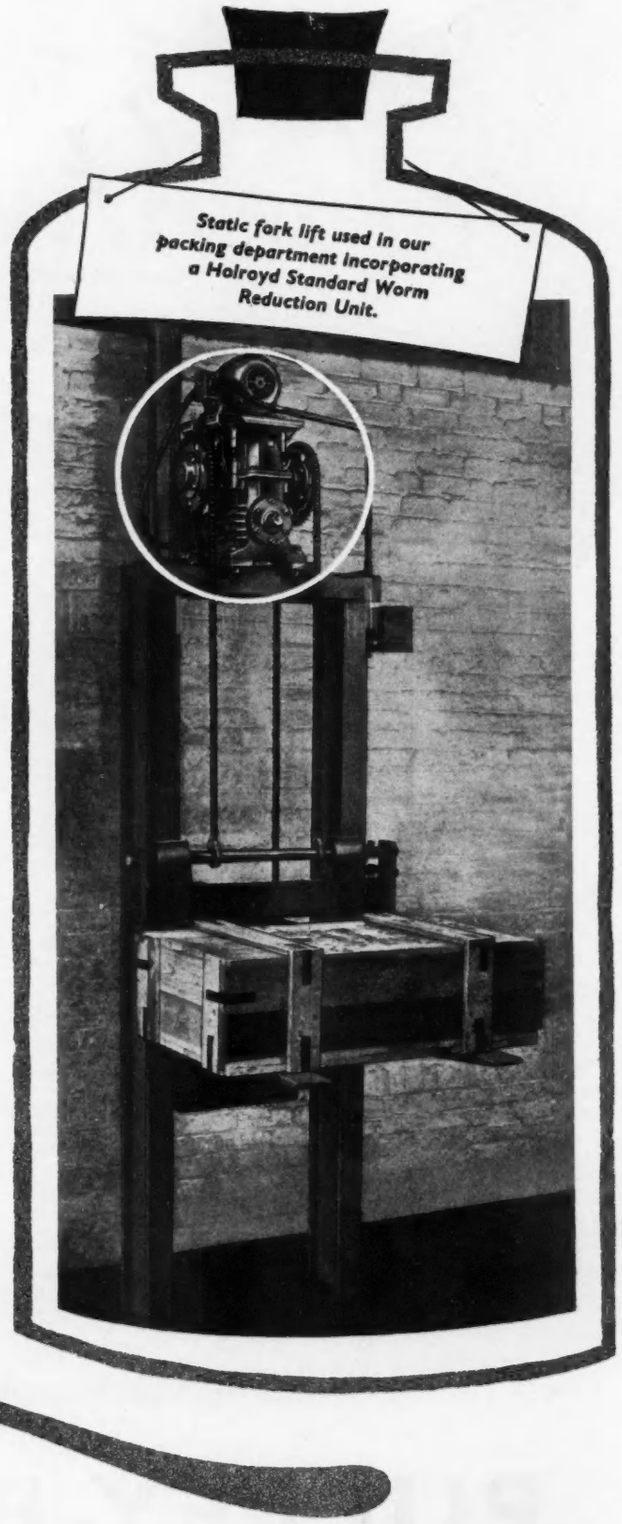
SIZES ¼ TO 5 TONS. WRITE FOR SECTION 98/4.

HERBERT MORRIS LTD., P.O. BOX 7, LOUGHBOROUGH

Taking our own medicine



A dose of our own medicine has proved a real pick-me-up in our Packing Department. It's a home-made static fork lift and the reason it works so well is that it incorporates one of our own standard Worm Reduction Units. "Doctor" Holroyd's famous Worm Units are made from special metals, are rigorously tested, backed by 50 years' experience—and available to one and all. If you'd like a dose it can be . . .

MADE UP FOR YOU QUICKLY

A Standard Type Holroyd Worm Reduction Unit with a stock ratio can be made up, packed and despatched to you fairly quickly. Worms, wheels and special units made to order take somewhat longer. For information on our Worm Units and their applications drop us a line at Milnrow, Lancs. We'll be glad to help you all we can.

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CRC 173

Oiling the wheels of industry—

OPEN-CAST MINING

For every modern industrial process there is a specialised grade of Sea Shell Lubricant

leadership in lubrication

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Surely we don't buy welding from all these gentlemen, Jezebel?

Deal with Quasi-Arc for *all* your arc welding—and so do business with one face you get to know and learn to trust. It's commonsense—because Quasi-Arc are the only arc-welding people who can offer you *everything*.

Yes, whether it's electrodes, equipment or manipulators, you can get them quickly from Quasi-Arc. And what is more, you will be dealing with a firm that is thoroughly equipped for service and research, and with the range of welding interests to give you unbiased advice on the choice of welding processes.

So when you strike an arc-welding snag, ring Bilston 41905—and get your Quasi-Arc man cracking. He can deliver the right goods and give the right answers quickly, every time.

The interests and activities of The Quasi-Arc Company Limited and Fusarc Limited in the well-known processes

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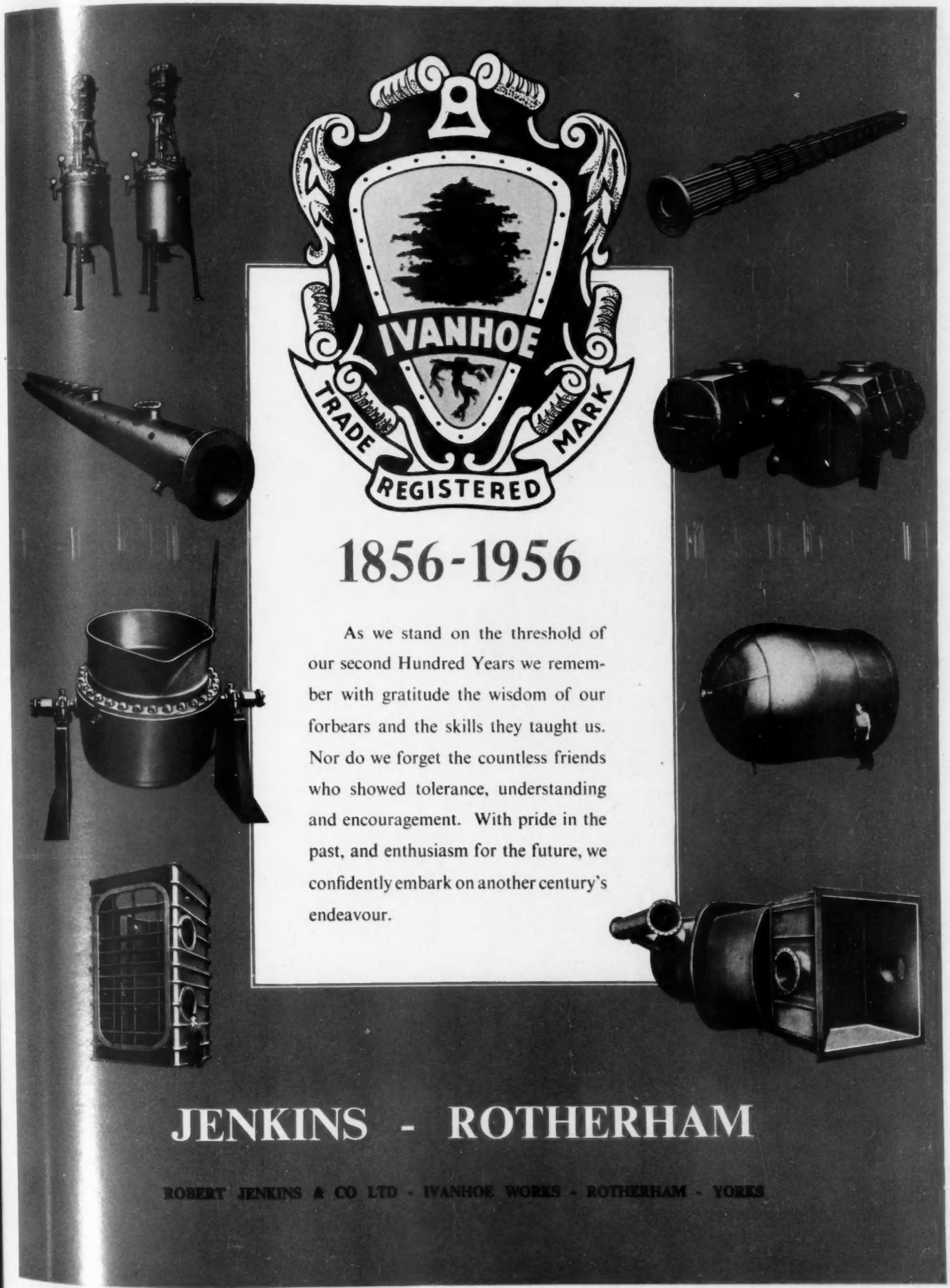
have been combined in order to provide a thoroughly comprehensive and effective service to the welding industry. The headquarters of the new organisation—named Quasi-Arc Limited—are at Bilston, Staffordshire, with works at Bilston and Gateshead.

Only QUASI-ARC LIMITED offer you everything

QUASI-ARC LIMITED, BILSTON, STAFFORDSHIRE



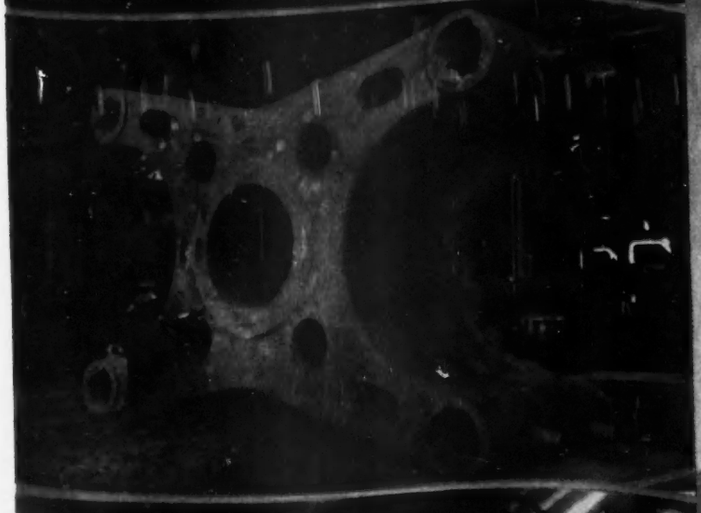
1856-1956

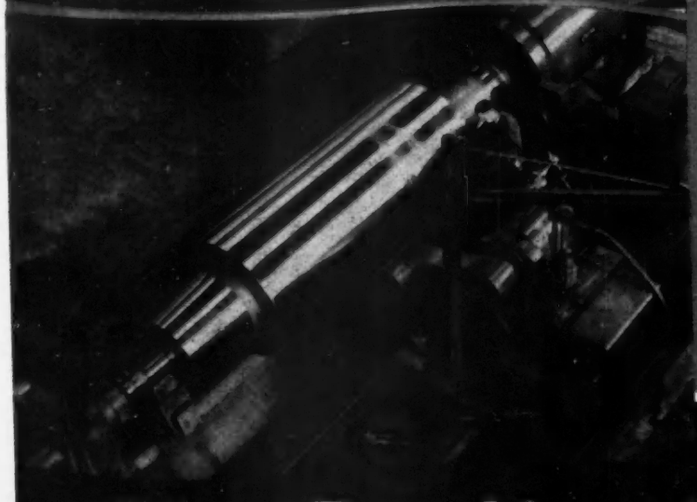
As we stand on the threshold of our second Hundred Years we remember with gratitude the wisdom of our forbears and the skills they taught us. Nor do we forget the countless friends who showed tolerance, understanding and encouragement. With pride in the past, and enthusiasm for the future, we confidently embark on another century's endeavour.

JENKINS - ROTHERHAM

ROBERT JENKINS & CO LTD - IVANHOE WORKS - ROTHERHAM - YORKS

Over 100 years service to Britain's Engineering Progress





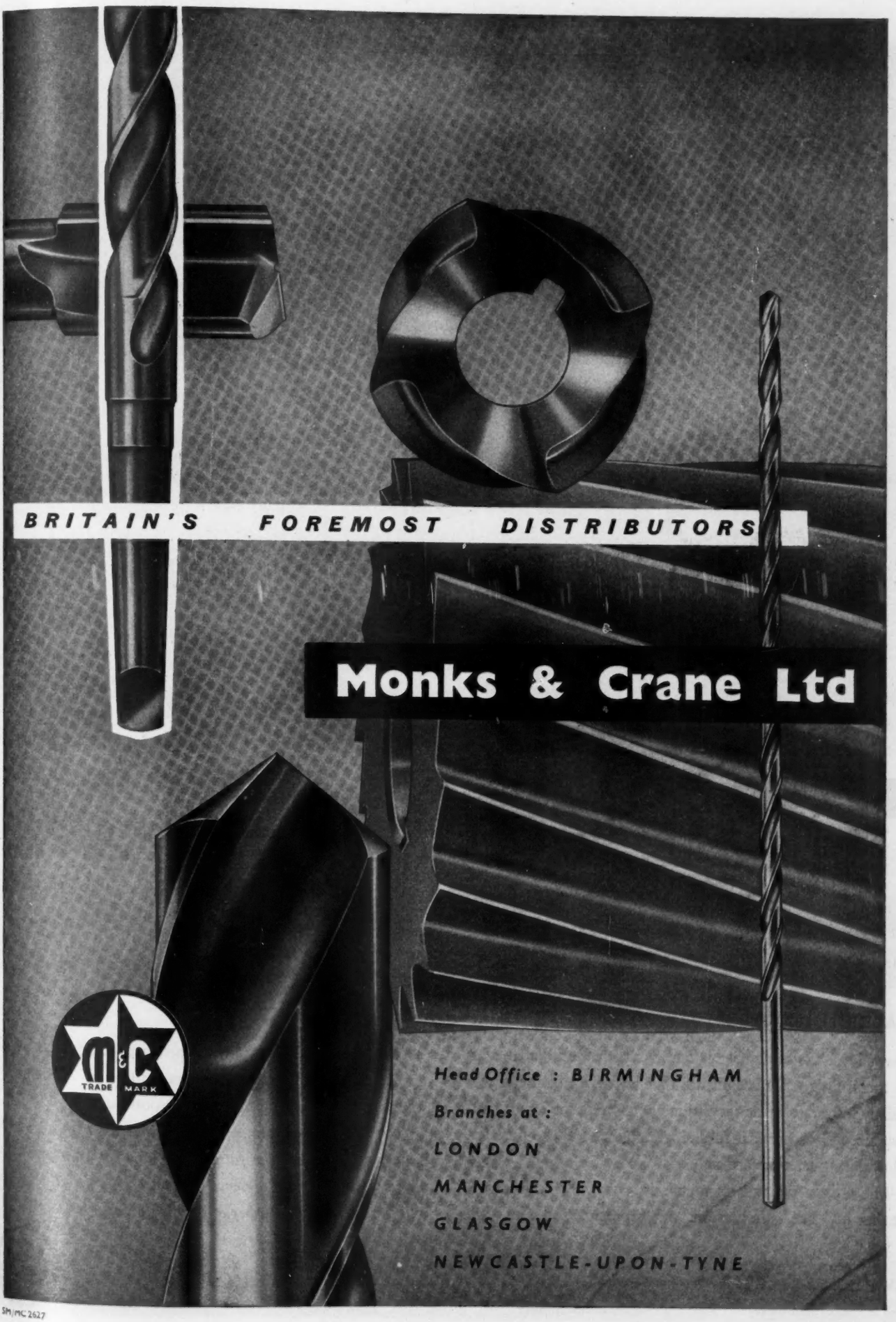
A Company's reputation is built up on the quality of the work which it produces. During the past 100 years the name of The Darlington Forge Limited has grown to be associated throughout the world with the production of Forgings and Castings of the highest order for the Marine and General Engineering Industries.

In the past, the Company's moulding pits and forging presses have produced structural and engine components for many of the world's greatest ships. Today they are making their own invaluable contribution to the expansion of Britain's heavy industrial capacity.

DF

The Darlington Forge Ltd

DARLINGTON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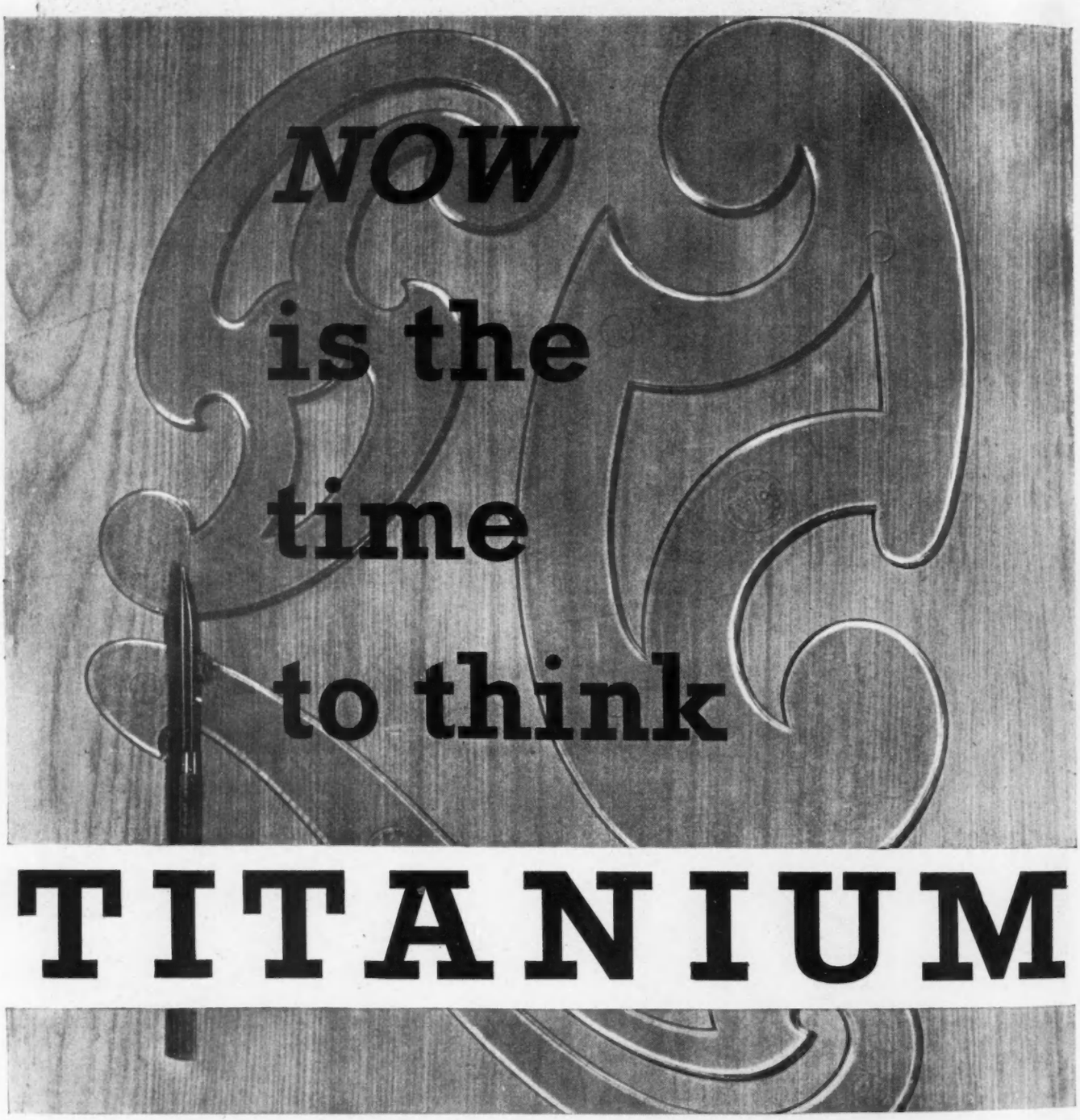

TITANIUM

TALKING POINTS No. 1... Titanium and Corrosion-Fatigue

Nowadays every engineer is familiar with the phenomenon of metal fatigue. Recognising that any piece of metal will fail by alternations or repetitions of a stress far lower than that needed to break it in a single application, he fixes his allowable stresses accordingly.

The fatigue strength of metals is, however, reduced still further if the alternating or repeating stresses are accompanied by even mildly corrosive conditions. With most metals, allowable stresses must be substantially reduced to prevent failure by corrosion-fatigue.

Titanium is an exception. Tests carried out in air and in seawater show that the fatigue resistance of titanium is not affected at all by the presence of seawater—a result not found with the very large number of metals similarly tested.

IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1.

M419

A tractor is as good as its tracks

A jack of all the toughest jobs—that is the modern crawler tractor; but whether it is bulldozing, scraping, hauling or ploughing, it is the tracks that must take the strain every minute of the working day. Maximum strength, and maximum resistance to wear distinguish the tracks of a Challenger—the result of over fifty years' experience and progress. In the history of tracks and tracked vehicles the name Fowler is written in bold letters. As early as 1884 they were experimenting with a machine that could travel easily over rough ground. In 1924, lessons learnt during the First World War helped Fowlers to produce one of the first fully tracked crawlers, and in 1933 the first British crawler tractor to be fitted with a diesel engine was designed and manufactured by Fowlers.

Fowlers' engineers have benefited from experience in the past—they have produced tracks that can stand up to the most exacting conditions. Specially heat-treated plates for maximum strength, and the induction-hardening of track links, pins, bushes and track rollers ensure the longest possible life. Three master pins in each track make servicing as easy as for the rest of the Challenger.

More earth moved faster by Challenger

FOWLER LEEDS

A product of the Marshall Organisation—John Fowler & Co. (Leeds) Ltd., Leeds 10

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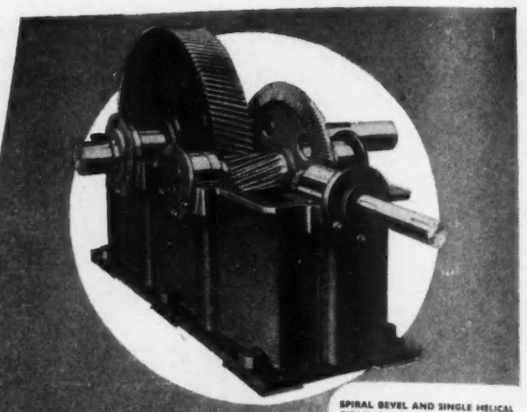
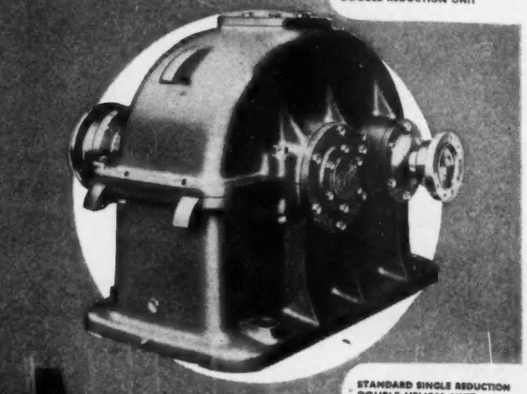
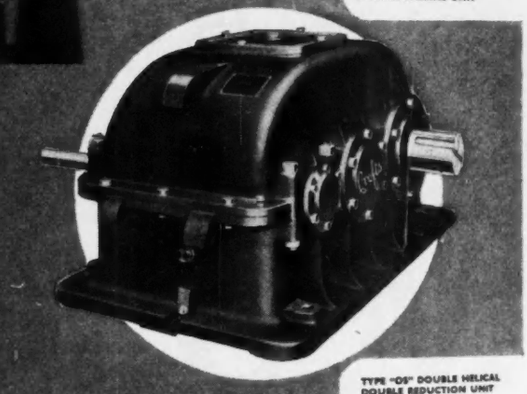
A DRIVING FORCE IN ALL MAJOR INDUSTRIES



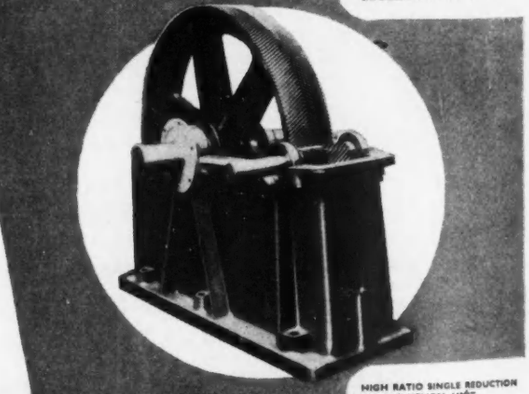
SPIRAL BEVEL AND SINGLE HELICAL DOUBLE REDUCTION UNIT



STANDARD SINGLE REDUCTION DOUBLE HELICAL UNIT



TYPE "DS" DOUBLE HELICAL DOUBLE REDUCTION UNIT



HIGH RATIO SINGLE REDUCTION DOUBLE HELICAL UNIT

Our range of standard double helical units covers all powers up to 3250 H. P. with ratios up to 50 to 1. Gear cases are either cast or fabricated and shaft extensions can be arranged to suit your requirements.

Apart from our standard range of double helical units, we specialise in the design and manufacture of gearing of all powers and speeds.

For full particulars write for Folder 535/11

Crofts (ENGINEERS) LIMITED. BRADFORD 3. ENGLAND

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WINDOGRID
Curtain Walling

PARLIAMENT HILL

COUNTY SECONDARY SCHOOL FOR THE L.C.C.

J. L. MARTIN, M.A., Ph.D., F.R.I.B.A., ARCHITECT TO THE COUNCIL

PHOTOGRAPH SHOWS 8,700 SQ. FT. OF *WINDOGRID* ON THE WEST ELEVATION.

A TOTAL AREA OF 20,000 SQ. FT. HAS BEEN INSTALLED IN THIS SCHOOL.

Send for List 295

HENRY HOPE & SONS LTD

Smethwick, Birmingham & 17 Berners St., London, W.1

MEMBER OF THE METAL WINDOW ASSOCIATION

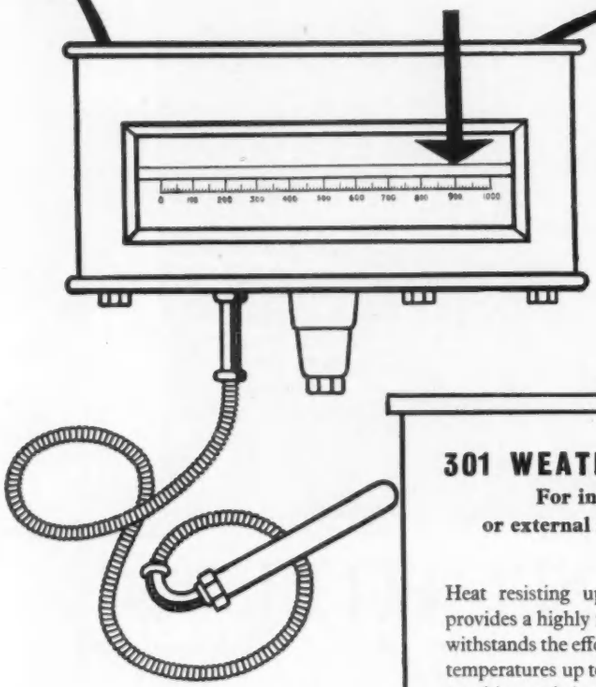
Coal conveyors and structural steelwork painted with EVODE Aluminium 301 at Thornhill Power Station.

Cyanide hardening crucibles and heat-treatment ovens painted with EVODE Aluminium 302. (Courtesy Fairbairn Lawson Coombe Barbour Ltd., Leeds.)

HEAT RESISTANT UP TO 900°F.

EVODE

ALUMINIUM PAINTS



SEND FOR FULL DETAILS OR ASK OUR REPRESENTATIVE TO CALL

301 WEATHERPROOF

For internal or external application

Heat resisting up to 450°F., 301 provides a highly flexible film which withstands the effects of Flue Gases, temperatures up to 450°F., intensive sunshine and the weather cycle and is recommended as an anti-corrosive coating for all metal surfaces. It prolongs the life of constructional steelwork, steel buildings, storage tanks and all constructions of metal subjected to corrosive influences in any way.

302 HEAT RESISTING

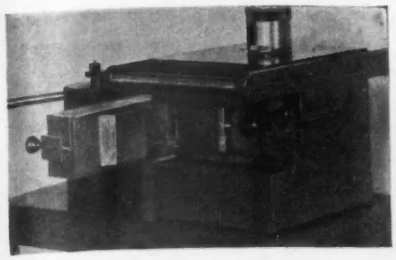
up to 900°F. for internal application

302 is ideal for all metal parts which are subjected to extremes of temperature—heating systems, exhaust pipes, flue pipes, steam boilers, etc., and for the lower parts of chimney stacks provided these are under cover. 302 will withstand even a dull red heat.

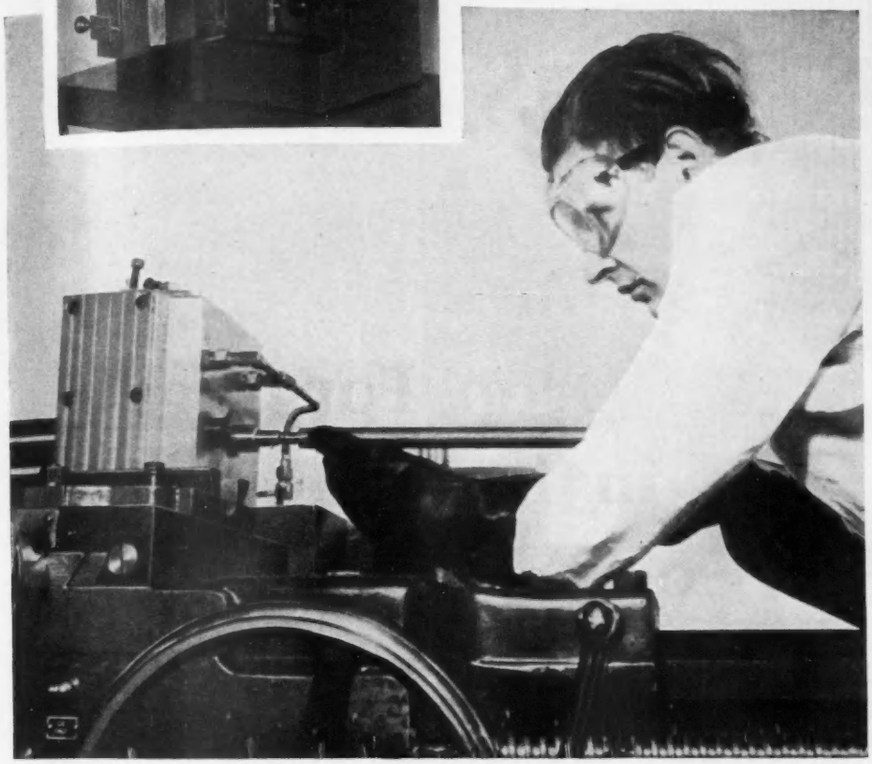
AN EVODE PRODUCT

EVODE LIMITED (PAINTS DIVISION) STAFFORD ENGLAND

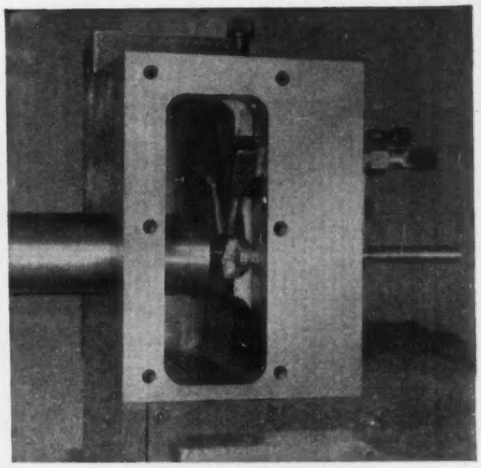
Telephone: 1590/1/2 Telegrams: Evode, Stafford London Office: 1 Victoria Street, S.W.1 Telephone: Abbey 4622/3



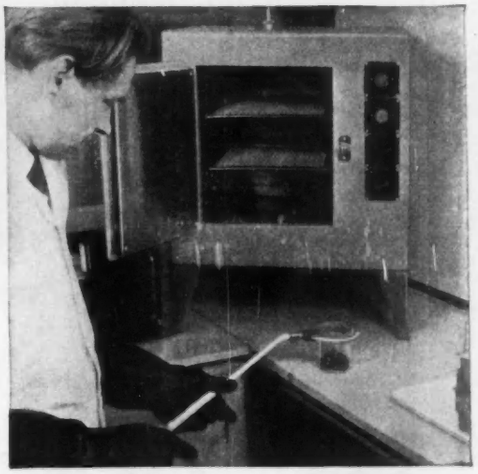
From this lead and steel storage chamber, radio active tool tips are extracted by remote control.



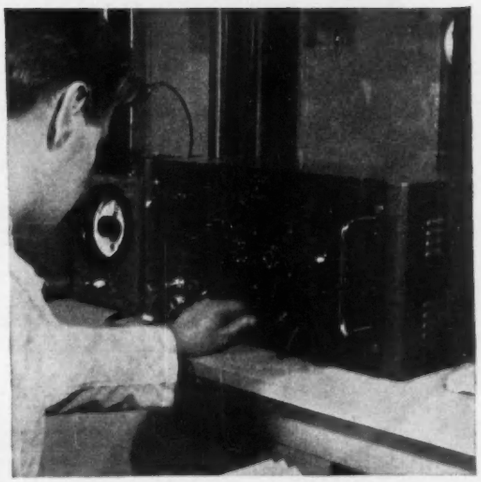
Rendered radio active in the atomic pile at Harwell a tool tip in special tool holder is inserted into the screened cutting box on the test lathe in Duckham's laboratories.



Inside the enclosed cutting chamber a 'standard' cut is taken on the work piece while a controlled flow of cutting fluid is directed on to the work. A ten second cut is usually sufficient to produce a working sample of cuttings.



Only 50 grams of cuttings are necessary to give an indication of the amount of tool wear products present. Before their radio-activity is measured the cuttings are weighed, washed and oven dried.



A scintillating counter accurately records the radio-activity of the cuttings. The amount of radio-activity from any sample is an accurate indication of the wear on the tool.

DUCKHAM'S

NEW RADIO ACTIVE TECHNIQUE

measures effect of coolants on tool life

10 second cutting determines tool wear factor

LUBRICATION specialists Alexander Duckham & Co. Ltd. now use radio active tracer elements to determine the effect of a coolant on tool life. By this method, 10 secs. of cutting time suffices for each test and an accurate comparison of wear can be made in a few hours. To obtain similar, but less accurate results by standard test methods several weeks' work is involved.

This modern method of testing is of immense value to the production engineer faced with the problem of greater productivity. Duckham's can solve your cutting oil problem. Their technical staff, backed by experience accumulated over more than 50 years, is at your service to advise and guide on all problems concerned with the use of neat and soluble coolants.

Duckham's CUTTING FLUIDS

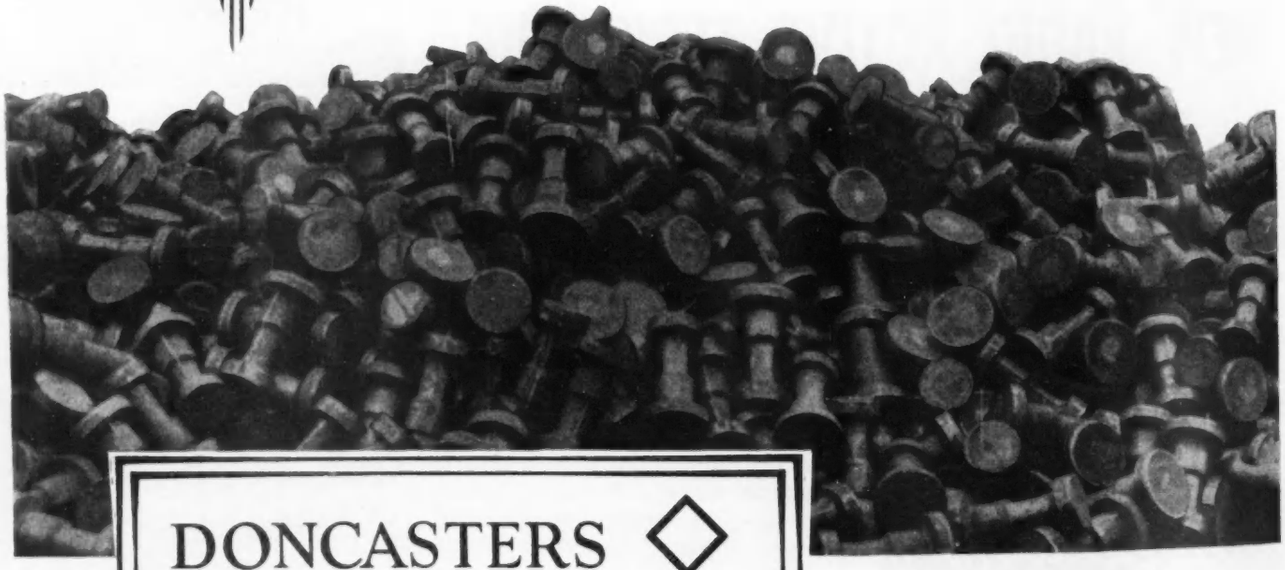
★ ★ ★

Here is a selection from Duckham's fine range of cutting fluids—**Transcut 50** (clear type soluble) unsurpassed for rust control; **A.T. Aquicut** (opaque type) first quality all-purpose grade; **K.A. Kemcut** (compounded additive oil) and its alternative, **S.A. Sulfcut** (sulphurised) for more difficult operations particularly on tougher types of steel.

A booklet—Cutting Fluids & Machine Shop Lubricants is available from Industrial Sales Dept., Alexander Duckham & Co. Ltd., Hammersmith, London, W.6

DONCASTERS

for
Drop Forgings
in large
or small
quantities



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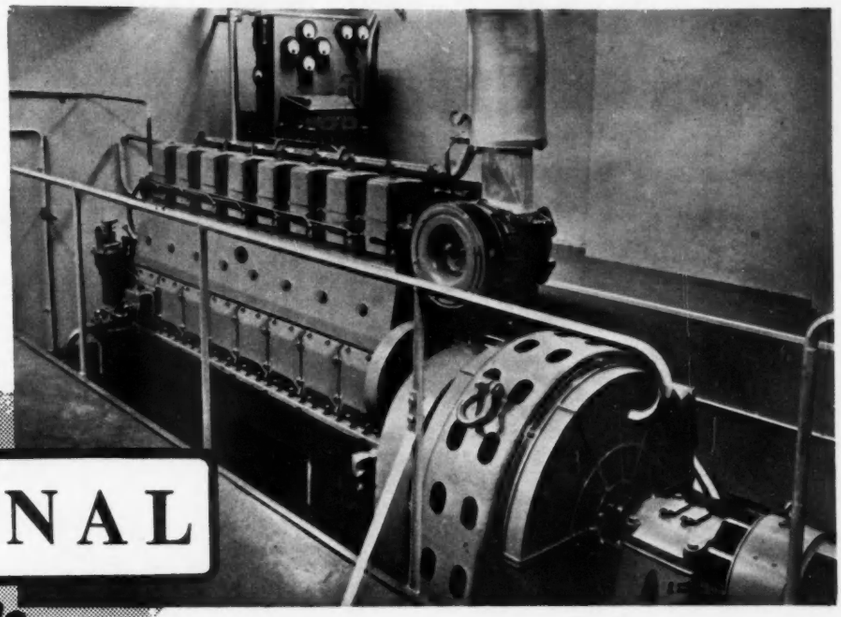

NATIONAL diesels

provide *emergency* power and lighting for a well-known South African newspaper . . .

In the 'Cape Argus' newspaper printing plant, a National "R4AU8" type 660 b.h.p. pressure charged diesel engine drives a 500 kVA alternator for emergency supply.

Argus Building, Cape Town

Whatever happens, that daily miracle, the newspaper, must go to press: It is therefore especially important to guard against failure of electric supply. The National diesel engine is particularly suited for emergency use in these conditions, as it can be started up at very short notice and will provide power and lighting at economic cost.

"The Cape Argus" relies upon National diesels as a safeguard in emergencies.

THE NATIONAL GAS AND OIL ENGINE CO. LTD., ASHTON-UNDER-LYNE, LANCASHIRE

A Member of the BRUSH Group

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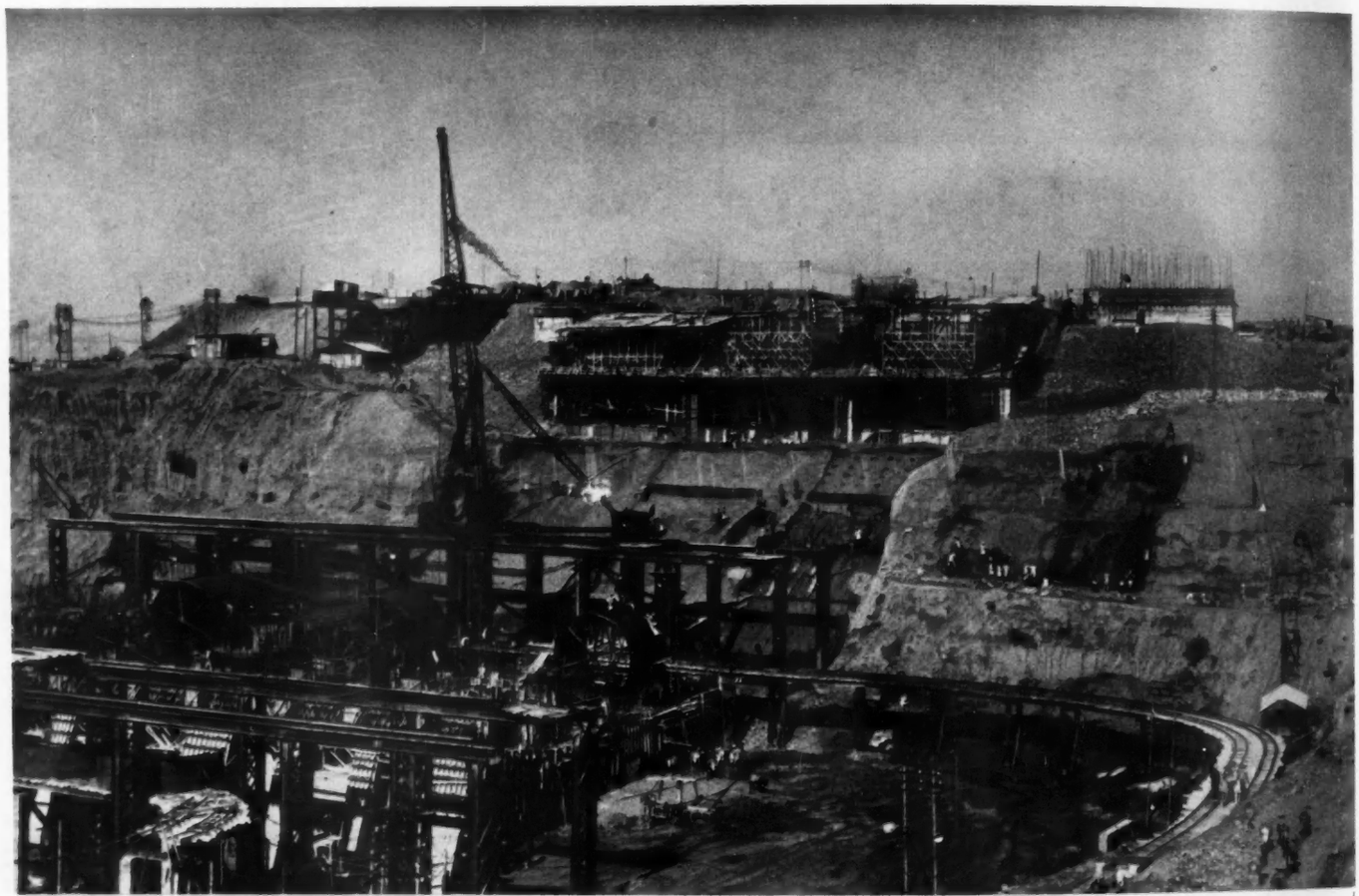
ATLAS COPCO EQUIPMENT IN ACTION ON INDIA'S MIGHTY BHAKRA-NANGAL PROJECT



A power house under construction on the Bhakra-Nangal project. A wide range of Atlas Copco equipment and Sandvik Coromant steels have been used on many excavating and tunnelling operations on the project.

The turbulent River Sutlej is being harnessed under India's £113,000,000 Bhakra-Nangal project. It has three major aims. To prevent flood disasters, to irrigate six million acres of land, and to provide enough electricity for over 100 towns.

The Bhakra-Nangal project naturally means an immense construction programme. It includes the huge, 680-foot-high Bhakra Dam on the Sutlej. This is one of the highest ever planned in the world and the most important feature of the project. The dam will form a reservoir behind it with a capacity of 7.4 million acre feet of water, and the power houses at Bhakra will have an installed generating capacity of 1 million kilowatts.

57 MILLION CU. YARDS OF ROCK

Atlas Copco rock drills, Sandvik Coromant steels and a wide range of other Atlas Copco compressed air-equipment have been extensively used in excavation operations to construct the Bhakra Dam. These include excavations for the site of the dam, 575 feet wide at the base, for two cavernous diversion tunnels, each about 2,500 feet long, with the impressive diameter of 50 feet, and for four penstock tunnels. All told, this entailed the excavation of 57 million cubic yards of rock.

On other excavating operations for the Bhakra-Nangal project, Atlas Copco drills and Sandvik Coromant drill steels have again been chosen, along with Atlas Copco compressors, sump pumps, rock breakers, drill steel grinders and riveting tools.

Among equipment excavating for the foundations of the 680-foot-high Bhakra Dam are Atlas Copco rock drills fitted with Sandvik Coromant tungsten-carbide-tipped steels.

ATLAS COPCO DRILLS AND SANDVIK COROMANT STEELS ARE IN ACTION ALL OVER THE WORLD

Atlas Copco compressed air equipment is being used again and again on many more important projects throughout India. Since Atlas Copco light rock drills and Sandvik Coromant steels were introduced there five years ago, this equipment has been chosen for practically all Indian tunnelling projects of any size.

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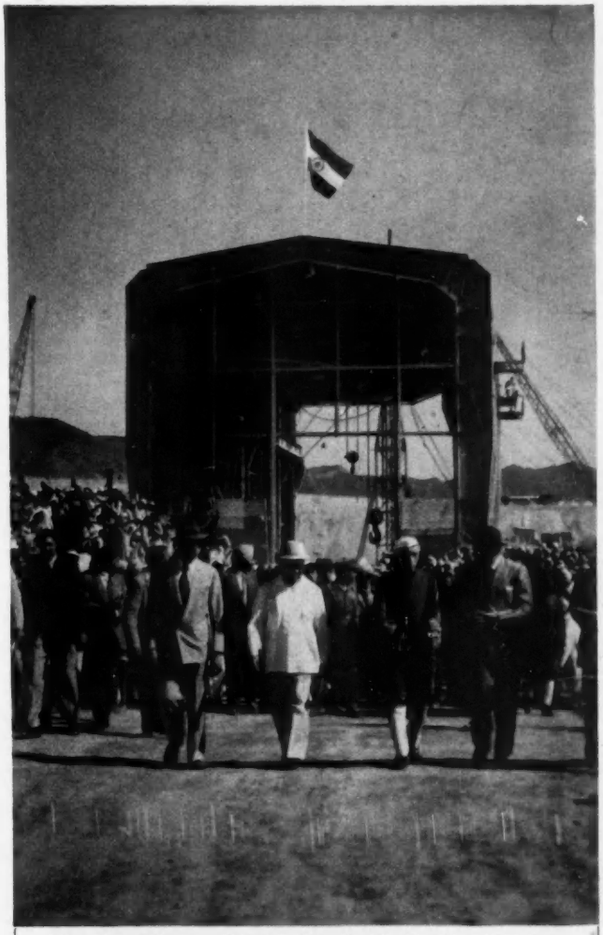

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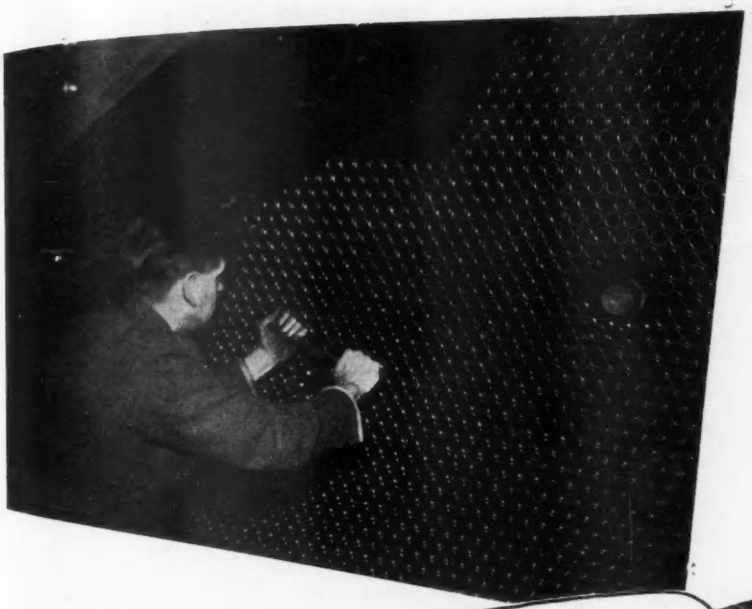

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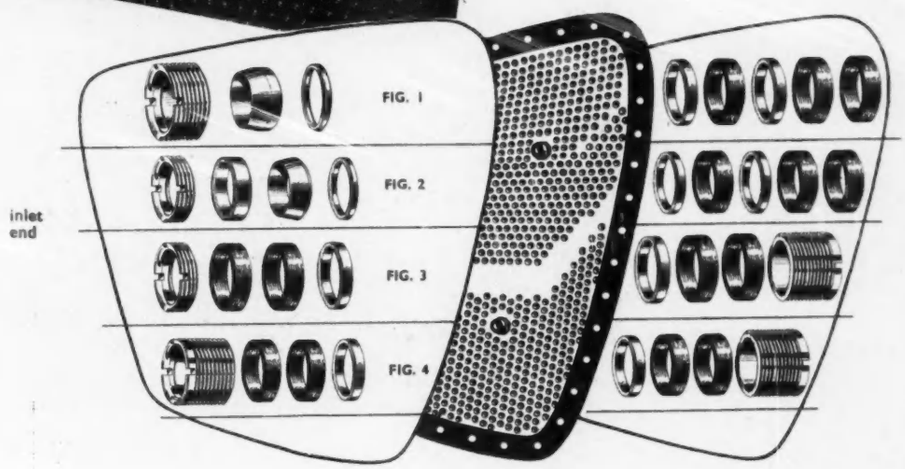

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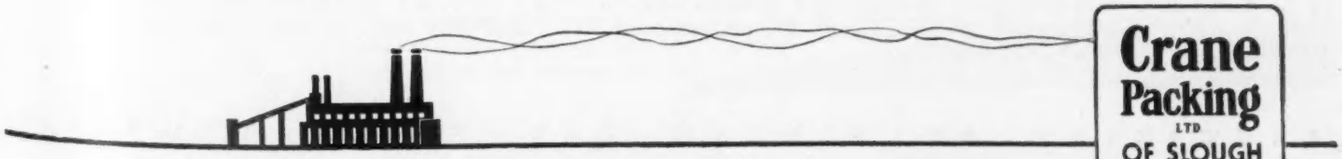

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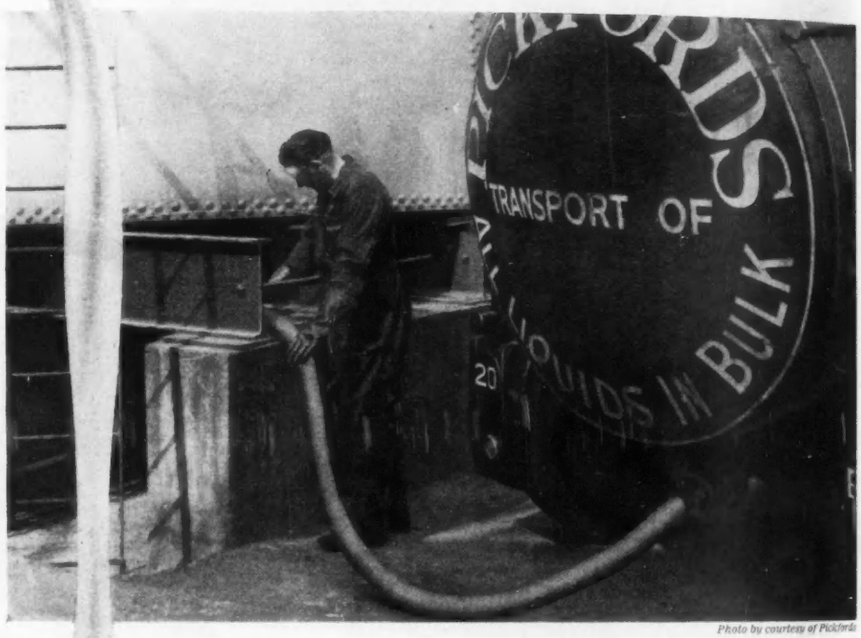

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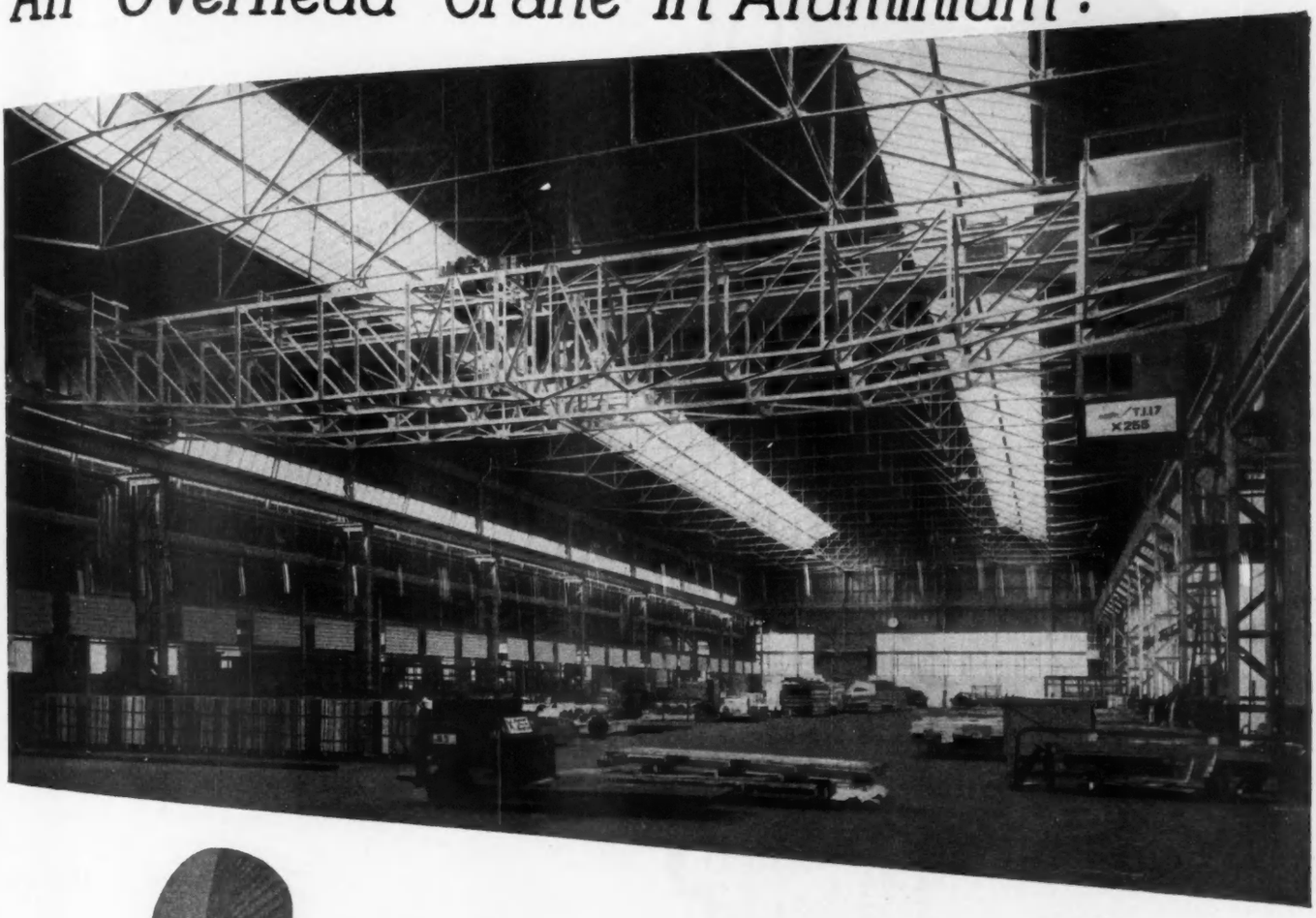

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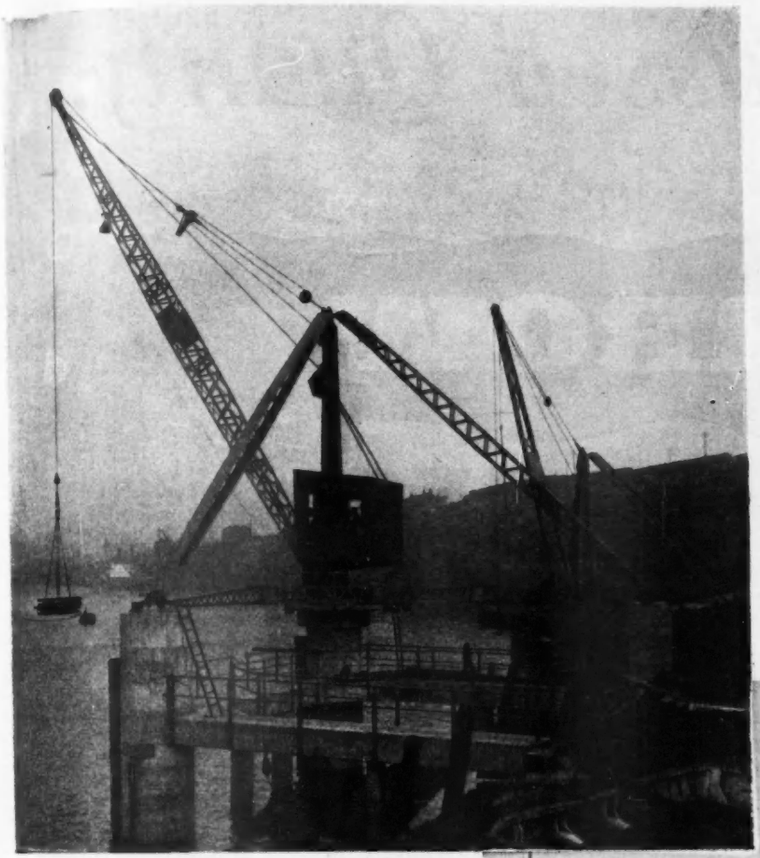

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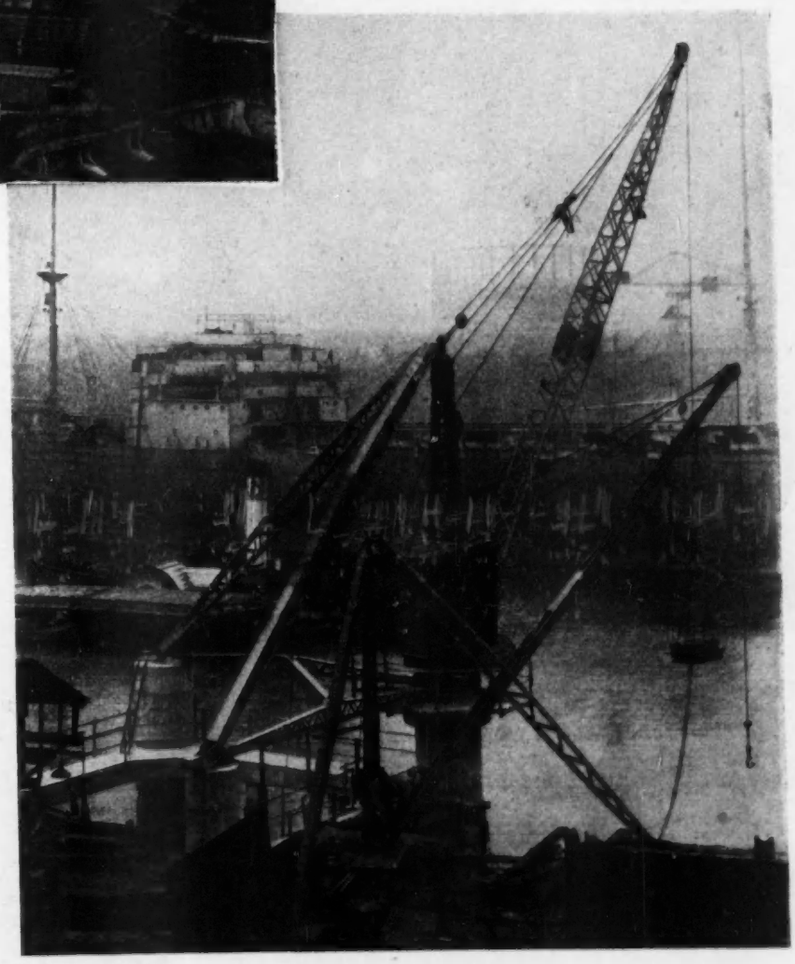

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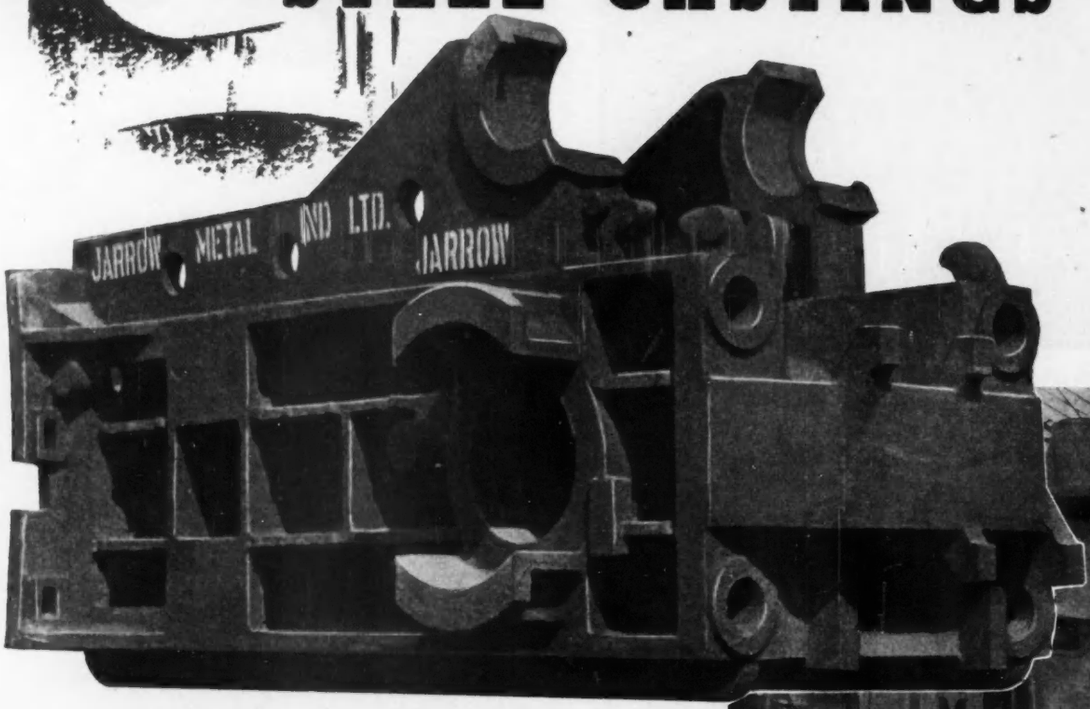

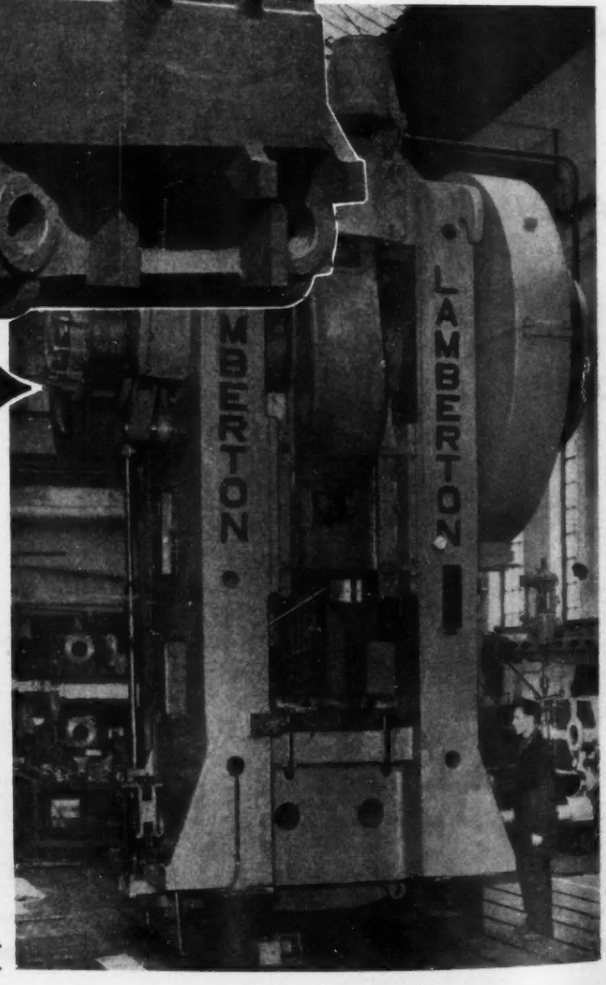

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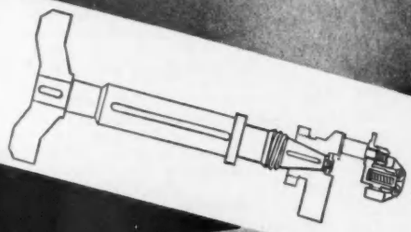

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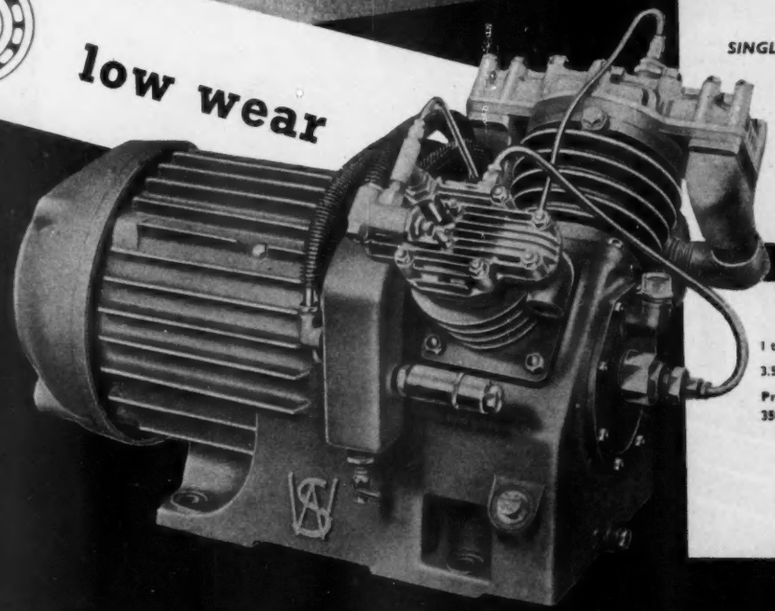

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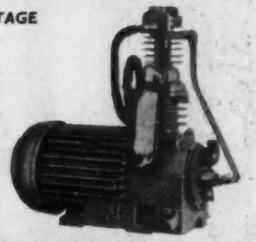

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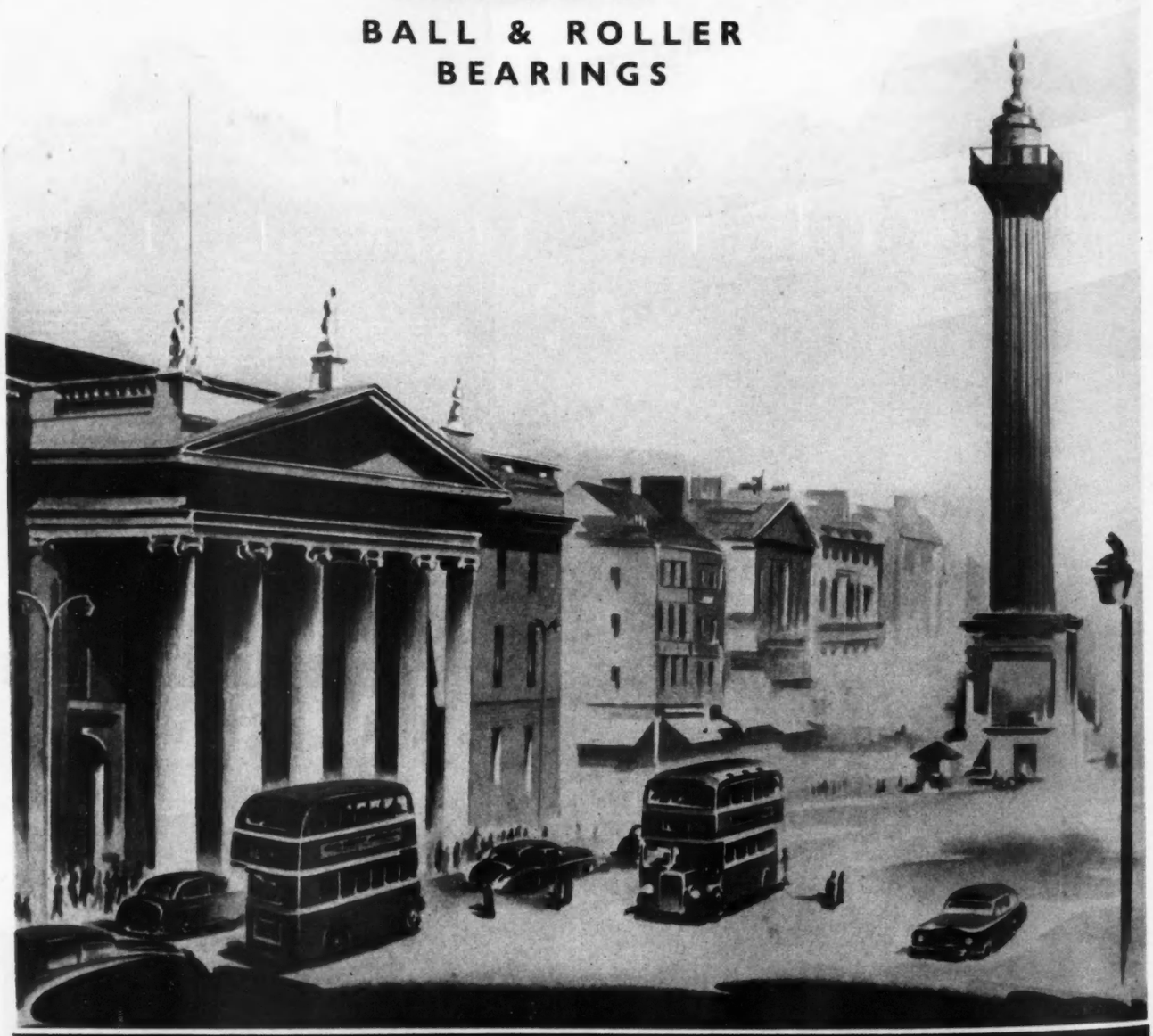

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ENGINEERING

An Illustrated Weekly Journal

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THE NEED FOR ENERGY

THE people of an island which, as a famous politician once said, is "built on coal and surrounded by fish," cannot easily accept the fact that they may find themselves one day without a source of heat, light and power. The much publicised, but little understood, marvels of atomic energy have generated a cosy feeling that there is nothing much to worry about except the price of coal and that provides an excuse to attack the Coal Board and blame the miner for not working harder. Few people realise that the shortage of fuel is a growing problem for the whole of Europe or that Britain's coal is cheaper than that of any country on the Continent except possibly Poland. The report of the O.E.E.C. committee of experts under the chairmanship of Sir Harold Hartley has brought out the fact that the need to import fuel on a large scale is a growing problem for all the member countries of that organisation and that it is not going to be solved in this century by the development of atomic power.

Europe's demand for energy in all its forms has been rising since 1948 by 4·8 per cent. a year, and the contribution made by coal has fallen from 79 per cent. to 70 per cent. of total requirements. Out of an estimated increase in the requirements of energy in the next 20 years from 730 to 1,200 million tons of coal equivalent, indigeneous production can only be expected to provide 170 million tons and the balance will have to be imported and paid for largely in dollars. Most sources of hydro-electric power will by then have been developed and the main hope of a reduction in the burden of the balance of payments of the countries concerned will lie, according to this report, in an expansion of the mining of coal, of which there are reserves sufficient to last for centuries.

This is no doubt welcome support for the Minister of Fuel and Power in his battle with the Tory rebels who want to shackle the Coal Board in its investment programme. The report points out that the share of investment in coalmining in O.E.E.C. countries is forecast to fall from 19 per cent. of investment in all forms of energy in 1954 to 9 per cent. during the period 1955-1975, and the industry is everywhere regarded as static or even dwindling. The over-optimism engendered by the atomic energy programme has had adverse effects on recruitment, investment and scientific development.

It is surely time that a realistic assessment of the economics of the construction of atomic energy plants and of further investment in coal production was made which took into account in each case both the research and development costs involved and the availability of constructional resources. The atomic energy programme is a great consumer of scientists, technologists and design engineers and its pace of development must to some extent be weighed against the advantages to be gained from the introduction of scientific methods into coal production. Might it not be that a fraction of the money at present spent on research into some of the exciting developments of modern science, if applied to the methods of mining coal, would produce surprising results?

A radical revision of some of their habitual methods is now required of the fuel and power industries as well as of their users. The handicap of traditional modes of thought is demonstrated by the reluctance displayed both by the Coal Board and the Central Electricity Authority to devote resources to the building of pilot plants for the generation of electricity from the underground gasification of coal. If the existing authorities are unwilling to push it forward with enthusiasm there is a case for the formation of a new and special body to do so.

The rising price of fuel may in the end do what exhortation has so far failed to do: force consumers, domestic and industrial alike, to invest in fuel-saving devices and to perform those simple tasks, such as lagging pipes and insulating roofs, which themselves can contribute so much to fuel economy. There is, however, one major source of waste which one suspects continues because the Central Electricity Authority judges the national interest as only forwarded by the increasing thermal efficiency of its own plants. This is not, of course, the case, as the Herbert Committee implied when it recommended greater co-operation between the local Electricity Boards and industry in the installation of private generating plant where the pass-out steam can be used for heating or process purposes. What has happened to this recommendation? It has been said that district heating schemes are uneconomic and this is no doubt true if they are considered in isolation; but has there been any serious consideration of the economics of small local generating plants combined with such schemes or is this consideration prevented by the bureaucratic boundaries within which large organisations jealously confine their thinking? This is not the sort of proposal which the non-informed layman or unscientific administrator can be expected to appreciate; but it is one to which engineers should continually give publicity. Perhaps it is only by engineers that the general public, the politicians and the Government can be brought to realise the energy gap that faces us and the ways to bridge it.

Plain Words

"The number of people we can employ cannot be determined by strikes, or by our emotions; it depends entirely upon the demand for our products." Plain words indeed, from Mr. Alick Dick the managing director of the Standard Motor Company, and plain common sense in the bargain. The likelihood of a further cut in car output by the company in the autumn was the shadow that hung over the York meeting of the unions. The meeting achieved a great deal.

The feeling of the men is that they should have the support of their comrades in the car plant for the introduction of short-time on a rota basis, which would reduce the earnings of the car workers. This meant taking a cut in wages by some 6,000 people to avoid temporary unemployment by 2,500 people. The management had refused such an arrangement on the ground that it is unworkable, and therefore uneconomic, at a time when car production costs threaten further cuts in output. There were demands for strike action, but this was not put to a vote, and there was no strike. There was also no settlement.

Now the ball has been thrown at the Government's feet. Mr. H. G. Brotherton, president of the Confederation of Shipbuilding and Engineering Unions, who chaired the York meeting, led a deputation the following day to state the men's case to the Minister of Labour and his advisers. Briefly this was that the unions consider the company unduly pessimistic about the prospects of the motor-car industry; that they should "assume some financial responsibility" for the present redundancies and give a trial to the shop stewards' proposals for a shorter working week and other measures. They argued that such action would give a breathing space for further consideration of the whole matter. They warned the Minister that there was still some pressure for a strike and that urgent action was needed. The Minister expressed his sympathy but emphasised that workers could not expect to have their jobs guaranteed when the demand for their employers' products fell.

This unfortunate affair has developed only because of the combination of an ambitious mechanisation programme with falling sales. The bitterness arose from what appears to the looker-on to have been a gross mishandling of human beings. Even now, as they await the decisions of the Minister of Labour, the shop stewards of the company protest at "the indiscriminate method of sacking."

The fear that this kind of thing will become commonplace if not resisted to the death at Coventry is, in our view, misplaced. We agree with Mr. Dick's remark at the head of this column. But the plight of highly paid workers, probably with hire purchase or housing loan commitments, having, at best, to take less pay, cannot and should not be ignored. For the efficient and progressive company there is no contradiction between automation and full employment.

Electric services from London (Liverpool Street) to Chelmsford came into operation on June 11, increasing the number of trains by eleven a day.

BY ELECTRICITY TO CHELMSFORD

COMPLETION OF ANOTHER STAGE IN THE ELECTRIFICATION OF BRITISH RAILWAYS

On Friday, June 8, one more step in the scheme for modernising British Railways was completed when the official opening of the electrified line from Shenfield to Chelmsford took place. The train bearing the official party left Chelmsford at 11.20 a.m., travelled to Shenfield and returned.

Speaking at the luncheon held at Chelmsford to celebrate the inaugural run, Sir Reginald Wilson, the Chairman of the Eastern Area Board of the British Transport Commission, recalled some of the earlier openings that had been held on this line.

He observed that each successive step in the progress of modernisation increased the value of the steps that had gone before, and said that he wished to pay tribute to the work of the engineers and technicians who had conceived the modernisation plan and who were carrying it out. They were of the same breed as those who had made British railways the finest in the world and they were intending once again to make them the best.

For all too long they had been handicapped by lack of money and opportunities. The cost of the modernisation scheme had been criticised in some quarters but, in actual fact, at least half of the £1,200,000,000 would have had to have been spent on maintenance work merely to keep the railways at their old standard.

The modernisation expenditure spread over 15 years amounted to approximately £40 million a year, which represented rather less than one per cent. on the investment held in existence at present day values. Such a sum ploughed in would hardly have been noted by earlier generations. In any case, to-day it represented approximately one twentieth of the amount spent every year on tobacco or on alchohol and less than one tenth of the amount spent on new housing. To make a different comparison, the total annual spendings would not amount to one fifth of the expenditure on roads and road vehicles. They were, in fact, trying to overhaul the neglect of two generations and providing themselves with a very handsome yield on the new investment.

The replacement in the rural areas of the steam train by the modern Diesel unit not only provided an improved service for the public but produced the return of between 20 and 30 per cent. per annum on the investment; the actual saving on the running of a Diesel train was approximately 6*s*. per mile. He would like to emphasise that all grades of staff were pulling their weight in the new plan and were trying to uphold the traditional motto of "Service" by the railways. In 1943 the journey from London to Chelmsford had taken 68 minutes at its shortest, and in 1956 it was taking 36 minutes.

RECENT WORK

Through electric train services between Liverpool Street, Ingatestone and Chelmsford came into operation on Monday, June 11. The 20 additional miles of track now to be worked with electric traction represent an extension of the Liverpool Street-Shenfield electrification opened on September 26, 1949, which was described in ENGINEERING, vol. 168, page 325, 1949. Main line steam services will be maintained to Chelmsford until electrification of the main line is projected beyond that point, and steam train timings will in some cases be improved. The electrification operates on the 1,500 volt direct current overhead system although provision has been made to convert it later to accord with British Railways national scheme for electrification on the 25,000 volt 50 cycles alternating current system.

The immediate benefits of this new extension of electrification will be an augmented and improved through service between Chelmsford and inner suburban stations, and a more frequent service to and from Ingatestone. The extension of course also forms an essential part of the eventual electrification of the Colchester main line to Ipswich and Harwich.

Electric trains at present running between Liverpool Street and Shenfield will be extended to serve Ingatestone and Chelmsford, giving 23 down and 25 up trains on weekdays. Local steam services at present operating between Shenfield and Chelmsford will be entirely replaced by electric trains. In addition two morning steam trains on weekdays and one on Sundays from Chelmsford and Ingatestone to

London will be replaced by electric services, as will two afternoon trains on Mondays to Fridays from London. Although it will not be possible to provide a complete interval service, outside the traffic peaks there will generally be an electric train each hour in both directions from Liverpool Street and Chelmsford with more frequent services in the rush periods. According to the number of stops made en route the overall journey time of the electric trains between Chelmsford and Liverpool Street will vary between 46 minutes and 63 minutes for the 30 mile journey and between 38 minutes and 55 minutes for the 24 miles between Ingatestone and London. After allowing for steam services replaced by electric, the net gain as a result of electric operation, in the number of trains serving Chelmsford on weekdays, is eleven down trains and 12 up.

At the same time as the new electric service came into operation, certain steam services between Chelmsford, Colchester, Ipswich and Norwich were replaced by multiple unit Diesel trains of the type described in the succeeding article.

The work of electrifying the section began in the spring of 1955. The extension is two-tracked and forms part of the main line to East Anglia. It is about 10 route miles in length and comprises about 20 single track miles.

Electrical energy at 33,000 volts, three phase, 50 cycles is supplied directly by the Eastern Electricity Authority to Hylands substation, situated about seven miles from Shenfield. There are no E.H.T. cables involved on the Shenfield-Chelmsford section.

Hylands is the only substation and has a single 2,000 kW mercury-arc rectifier. The equipment comprises one 500 MVA single busbar metal-clad switchboard having one 400 ampere rectifier breaker and duplicate 30 kVA plug-in type auxiliary transformers for substation auxiliaries and signal supplies. The 1,500 volt direct-current switchboard comprises one 2,000 ampere high speed circuit breaker and four 1,600 ampere direct current high-speed circuit breakers. A track sectioning cabin with four supervisorily controlled high speed breakers is situated at Ingatestone, approximately midway between the existing Shenfield substation and the new Hylands substation.

Both the substation and the track sectioning cabin are supervisorily controlled from the existing control centre of the Liverpool Street-Shenfield lines at Chadwell Heath. A pilot cable for the remote control of the substation and the track sectioning cabin is carried in concrete troughing along the lineside in conjunction with the signal and telecommunication cables.

The supply for signalling is given from either of the two auxiliary transformers at Hylands substation. A standby Diesel generator set is also provided which operates automatically on failure of the normal supply, to preserve continuity of power for signalling circuits.

OVERHEAD LINE EQUIPMENT

The overhead line equipment on the Shenfield-Chelmsford extension is broadly the same as that used on the Liverpool Street-Shenfield electrification (ENGINEERING, vol. 174, page 819, 1952); the main and auxiliary catenaries are of hard drawn copper and the contact wire is of a cadmium-copper alloy. The chief variations are that the total copper equivalent on the extension to Chelmsford is 0·6 sq. ins. per track against 0·75 sq. in., and also that span wire registration has been adopted instead of mechanically independent registration. The insulators used are of the cap and pin type.

Overlap spans are provided at convenient points along the line which is thus sectioned electrically not only at the substation and track sectioning cabin, but also by hand operated switches at certain strategically placed overlap spans. Direct current feeder cables from the substation and track sectioning cabin are laid in concrete troughing at surface level to their respective switches mounted on the structures. The line is bonded throughout for traction return current, all rails being used for the most part in conjunction with impedance bonds to segregate the traction and signalling circuits. Single rails are used where points and crossings occur.

The structures supporting the overhead line equipment are mainly rolled steel joist section but in certain instances B.F.B. section has been used. Structures on which the line equipment is anchored are of fabricated type; all are galvanised. Spacing is up to a maximum of 240 ft. apart.

Installation of the foundations and erection of the supporting structures in open country sections of the line were carried out with the aid of earth boring, steel erection and concrete mixing units mounted on a construction train, which enabled the entire process of excavation, mast planting and concreting to be performed in sequence during one visit to the structure site. A description and illustrations of the work in progress was given in ENGINEERING, vol. 180, page 358, 1955. Much time was saved compared with the earlier method where manual excavation and concreting necessitated three separate visits to each structure location.

Colour light signalling operated by direct-current power was installed between Shenfield and Chelmsford in 1937, but the use of 1,500 volt direct current power for traction necessitated the conversion of the signalling equipment to 110 volt alternating current 50 cycles operation to render it immune from interference from the direct current traction supply.

The conversion involved the construction of new relay rooms at Ingatestone and Chelmsford signal boxes and installation of lineside relay location cases to house new equipment.

The existing direct current searchlight signals were retained and operated from a 110 volt alternating current supply through a step-down transformer and selenium rectifier and the independent double filament lamps were increased to 12 watt main and 16 watt auxiliary.

In addition to reconstruction work, considerable pre-electrification maintenance had to be carried out. All cuttings and embankments on the route were strengthened. The track was lifted and relaid with standard flat bottom rails after the formation had been blanketed and re-ballasted and complete new drainage system installed. The track was re-aligned for high-speed running.

Three bridges (road-over-rail) between Ingatestone and Chelmsford were reconstructed to provide sufficient clearance for overhead line equipment. These bridges were re-decked with pre-stressed concrete beams after the brick abutments had been raised. Other overhead structures such as the station overbridges also had to be raised and minor platform alterations carried out at Chelmsford and Ingatestone stations.

The civil engineering work was carried out under the direction of Mr. A. K. Terris, B.Sc.(E.), M.I.C.E., Chief Civil Engineer, Eastern Region; Electrical Engineering under Mr. J. A. Broughall, B.Sc.(E.), M.I.E.E. and Signal Engineering under Mr. A. Moss, M.I.R.S.E., M.Inst.T., Signal Engineer, Eastern Region (retired April 30, 1956) and Mr. R. A. Green, M.B.E., E.R.D., A.M.I.E.E., M.I.R.S.E. who was appointed Signal Engineer, Eastern Region May 1, 1956. The overhead line equipment was supplied by British Insulated Callenders Construction Company Limited, and the substation equipment by British Thomson-Houston Company Limited. Siemens and General Electric Railway Signal Company Limited were responsible for the signalling installation and Richard Costain, Limited, for the civil engineering work.

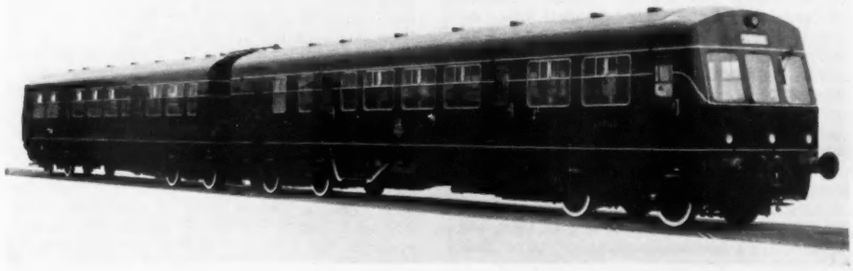

Fig. 1 Two-coach railcar sets consisting of a power car and a trailer are part of the modernisation plan for British Railways.

DIESEL RAILCAR SETS

TWO-COACH UNITS FOR BRITISH RAILWAYS

The modernisation programme for British Railways includes orders for Diesel railcars, of which 411 are to be made by the Metropolitan-Cammell Carriage and Wagon Company, Limited Saltby, Birmingham. In order to enable trains of different lengths to be made up, these cars will be delivered as two, three, four and six-car sets.

The first order, which is now being delivered, covers 36 two-car units, of which seven are for the Bury-Bacup service on the London Midland Region and the remainder for use in East Anglia under the Eastern Region. Each unit is made up of a power car and a trailer there being identical driving cabs in both so that the unit can be operated in both directions. A two-coach railcar set is illustrated in Fig. 1. The overall dimensions and the seating layouts are similar to those of the twin units being constructed by the British Transport Commission at Derby, but there are many differences in other parts of the design. Overall dimensions of both types of car are: length over buffers, 60 ft. 8 in.; width over body panels 9 ft. and overall 9 ft. 3 in.; bogie centres 40 ft.; bogie wheelbase 8 ft. 6 in. All the bogie wheels are 3 ft. in diameter.

The bodies of the cars are integral structures, and in them the side framing, made up chiefly from steel pressings, extends as a complete unit from below the underframe to well into the roof portion. This construction provides a structure which will take care of all superimposed loads. Spot-welded to the structure are the steel side panels in which the windows are mounted in aluminium frames. The special inside frames and the use of rubber seals allows the windows to be fixed at any time during the finishing of the cars, and also for them to be easily removed for repair or overhaul. Aluminium is also used for the framing members and outer sheets of the roof, and for the ventilators. The body ends are steel with doorway openings to allow a flexible gangway between the cars of the unit, and are shaped round the driving cabs for appearance and visibility. Standard steel passenger doors, with full drop windows, have been used.

The underframe members are made up from

rolled sections and fabricated units; examples of the latter are the end frames which are built complete with the headstocks and bolsters. Under test the body shells withstood a distributed load of 26½ tons, representing full equipment plus three times the normal seated load. This conformed with the Transport Commission requirement that the body should be capable of withstanding 200 per cent. overload. All units are jig-built to give interchangeability and to allow variations in layout to be constructed from more or less standard items. Standard buffing and drawgear has been incorporated, the buffers being self-contained with rubber springs.

The bogies for the trailer cars are conventional in type, with brake blocks mounted on both sides of all four wheels. An 18 in. standard vacuum brake-operating cylinder is mounted on the underframe. The driving bogies are designed to accommodate the drive on the inner axle, and have a 22 in. vacuum cylinder mounted on the outer end. This arrangement leaves the whole of the space between the bogies free for mounting the power equipment. All the bogie frames are built from fabricated sub-assemblies and rolled sections and plates riveted together. Swing bolsters are used with anti-sway hydraulic dampers to control the lateral motion of the cars. The springing consists of laminated side springs with india-rubber auxiliaries, and nests of coil springs in the bolsters.

UNDERFLOOR ENGINES

The power units and their associated controls are being supplied by the British United Traction Company, Limited, Hanover House, Hanover-square, London, W.1, and are in general similar to those already in use on some other railcars. There are two six-cylinder horizontal engines on each power car, of A.E.C. manufacture and 11·3 litres capacity, each developing 150 h.p. at 1,800 r.p.m. Each drives, through a hydraulic coupling and a short cardan shaft embodying a free wheel mechanism, a four-speed Wilson epicyclic gearbox. From the gearbox, a second cardan shaft takes the drive to another box, mounted on the inner axle of the driving bogie, which incorporates the forward and reverse gears. Electro-pneumatic controls govern the operation of the engines, Wilson gearboxes and the reversing gearboxes. All controls are grouped in the driver's cabs. Fuel for the engines is supplied from two 80 gallon tanks mounted below the floor, and one of these has a second compartment where fuel for the oil heater is stored. Direct-driven air compressors and belt-driven exhausters supply the control system and brake requirements respectively.

The interior layout of the power cars of the Bury-Bacup sets allows for 52 second-class seats in " saloon " formation, and a combined luggage and guard's compartment placed next to the vestibule leading to the trailing coach. In the trailing coach there is a lavatory compartment next to the vestibule, then two sections of 20 and

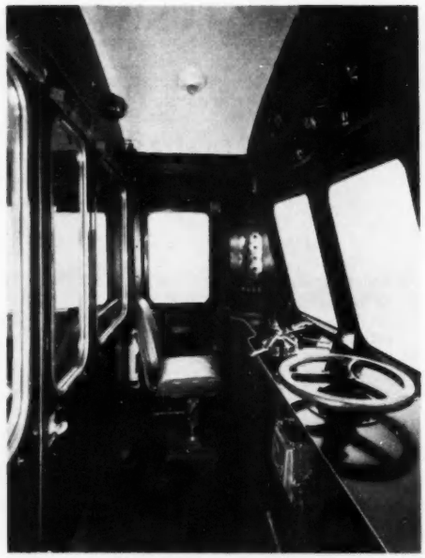

Fig. 2 Duplicate drivers' compartments are fitted in both power and trailer coaches.

33 second-class seats, divided by an entrance lobby but otherwise forming a single saloon, a second entrance lobby and finally 12 first-class seats next to the driver's cab. Fig. 3 shows the arrangement looking towards the vestibule. In the East Anglia sets, there are 56 second-class seats in the power cars and 72 in the trailer coaches; the luggage and lavatory compartments are retained but the first-class seating has been omitted. The second-class seats in both sets are arranged on both sides of a central gangway, there being three seats on one side and two on the other. In the first-class section there are only two seats in each side. Aluminium-framed luggage racks run the length of the coaches above the seats. Tubular construction has been used for the seat frames and the interior is generally free from obstructions. Plastic panelling has been used both for the sides and the partitions. Heating of the cars is effected by warm air carried in insulated ducting arranged along the bodysides with openings below some of the seats. The air used comes from an oil-burning heater which is fitted below the floor of each coach. Control switches for the system are mounted on the driver's table; operation is automatic and the system can be used to circulate unheated air in warm weather.

In the driver's compartment, shown in Fig. 2, the colours of which—maroon and black—have been chosen to minimise glare, all the controls are mounted on a single table which stretches the width of the coach. The hand-brake wheel is also mounted on this table, the front panels of which are removable to give access to the equipment, cables and junction boxes. The instruments include a speed indicator in each cab, and a mileage recorder operated from the leading axle of the power car. A windscreen wiper and twin horns are worked from the compressed air supply, and marker lights for the head code are fitted at both ends.

Fig. 3 In the second-class sections seats are placed three on one side and two on the other.

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Letters to the Editor

RAILWAY MOTIVE POWER

SIR, The recurring theme at the British Electric Power Convention at Torquay has been the bold decision of the British Transport Commission, based on the advice of the chief electrical engineer of its railways division, Mr. S. B. Warder, to adopt a system for the transmission of power from stationary generators to moving trains which is an advance on systems hitherto used in this country but which also involves overcoming many difficulties in its application to the conditions existing on our railways.

It is worth remarking, I think, that a century ago Torquay was served by the South Devon Railway Company, a small local concern whose main line had gradients which are still as steep as any on the trunk routes of the Commission. This small company had as its engineer, Isambard Kingdom Brunel, on whose recommendation it reached, in 1844, the decision to apply the power of stationary condensing engines to its trains by what was known as the " atmospheric system." The following extract from his report to the directors would have sounded quite topical at this Convention held adjacent to the ex-South Devon Railway. After showing that the adoption of the system would result in a reduction of capital cost he went on—

" But it is in the subsequent working that I believe the advantages will be most sensible.

" In the first place, with the gradients and curves of the South Devon Railway between Newton and Plymouth, a speed of thirty miles per hour would have been, for locomotives, a high speed, and under unfavourable circumstances of weather and of load, it would probably have been found difficult and expensive to have maintained even this; with the Atmospheric, and with the dimensions of pipes I have assumed, a speed of forty to fifty miles may certainly be depended upon, and I have no doubt that from twenty-five to thirty-five minutes may be saved in the journey.

" Secondly, the cost of running a few additional trains so far as the power is concerned is so small, the plant of engines, the attendance of engine-men, etc., remaining the same, that it may almost be neglected in the calculations; so that short trains, or extra trains with more frequent departures, adapted in every respect to the varying demands of the public, can be worked at a very moderate cost. I have no doubt that a considerable augmentation of the general traffic will be thus effected, by means which with locomotive engines would be very expensive, and frequently unattainable, particularly as regards one class of short trains, whether for passenger or goods, which from the inconvenience of working them by locomotives are hardly known—I refer to trains between the intermediate stations.

" By many means, which the easy command of a motive power at any time, at every part of a line, must afford of accommodating the public, I believe the traffic may be increased.

" It appears to me also that the quality of the travelling will be much improved; that we shall attain greater speed, less noise and motion, and an absence of the coke dust, which is certainly still a nuisance; and an inducement will thus be held out to those (the majority of travellers) who travel either solely for pleasure, or at least not from necessity, and who are mainly influenced by the degree of comfort with which they can go from place to place.

" Lastly, the average cost of working the trains will be much less than by locomotives.

" With the gradients of the South Devon Railway, and assuming that not less than eight trains, including mail and goods trains, running the whole distance, and certainly one short train running half the distance, be the least number that would suffice, I think an annual saving of £8,000 a year in locomotive expenses, including allowance for depreciation of plant, may very safely be relied upon.

" For all the reasons above quoted, I have no

hesitation in taking upon myself the full and entire responsibility of recommending the adoption of the Atmospheric System on the South Devon Railway, and of recommending as a consequence that the line and works should be constructed for a single line only."

It is also interesting to note that on the basis of a cost of coal of sixteen shillings per ton the cost of production of energy by stationary engines was 0·25*d.* per hour compared with 1·098*d.* per hour by locomotives.

Quite clearly, if Brunel had had available the electric motor instead of the atmospheric piston —if he had followed Faraday instead of being his contemporary—electrification of this main line would have been an accomplished fact a century ago. Shortly before nationalisation, the former Great Western Railway did, of course, consider a report on the electrification of the main lines west of Taunton, covering this very route. It is also worthy of remark that the largest single problem in applying the 25 kV overhead system in this country—the lack of clearance in bridges and tunnels which necessitates the use of 6·6 kV on some sections, with all the switching complications involved—just does not exist on the main lines for which Brunel was responsible. The atmospheric system was before its time, and the broad gauge was just too late, but at least the clearance is there.

Another far-sighted engineer who should be remembered at this time is Philip Dawson of the Brighton line, the only man who made provision for main line electrification in this country half a century ago. His 25 cycle single-phase system, for all its minor faults, was a financial success even on the suburban routes on which it was first installed, but he intended these to be only the first stages of a main line scheme, which would undoubtedly have followed but for the 1914-18 war, and the railway grouping of 1923, by which time the L. & S.W.R. and S.E. & C.R. had introduced purely suburban third-rail systems. In contrast to the third-rail system it would have catered for freight as well as passenger traffic and it would now have been readily convertible to 50 cycle supply.

When we reflect that the North Eastern Railway under Sir Vincent Raven was also virtually committed at that time to the electrification of its York-Newcastle main line at 1,500 volt D.C. and had, in fact, built a main-line locomotive, I think there is little doubt that one result of the grouping was to postpone main line electrification for over a generation. Events showed that the Weir report of 1931, which showed it to be a financial proposition, was too late.

Another company which would undoubtedly have readily extended its electrification of densely loaded lines, but which became the junior partner of a larger group, was the Lancashire & Yorkshire, led by another forward-looking engineer, Sir John Aspinall, who did successfully operate one short section at 3,600 volts D.C.

Yours faithfully,

J. R. HARDING.

Pirelli-General Cable Works Limited,
Southampton.
June 4, 1956.

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AUTOMATION

SIR, With regard to your leading article of May 11, I should point out that we have not set up any sub-committee to consider the question of automation.

Yours faithfully,

CHRISTOPHER POWELL,
Secretary.

The Parliamentary and Scientific Committee,
31, Palace-street, London, S.W.1.
May 16, 1956.

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The College of Aeronautics, Cranfield, Bletchley, Buckinghamshire, announce that MR. SEYMOUR WELLS, B.A., F.R.Econ.S., has been appointed Director of studies of the Work Study School at Cranfield. He expects to take up his appointment in July.

Weekly Survey

Cover Picture: *The advantages of phenolic resin for instrument plates are many. A fairly complicated form can easily be produced in numbers, precisely to the same dimensions and shape, without the need for extensive machining and drilling. The material itself is relatively stable mechanically, is an effective insulator, and has a good surface finish.*

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Facing the Future—Unofficial Version

It is a source of wonderment and, to some extent, of irritation from the engineer's point of view that the economists remain confident in their forecasts of the economic future despite the differences of opinion among themselves. It takes an impressive combination of boldness and humility to forecast so much with a slide-rule and a collection of partial data. The results achieved by the study section of the Royal Statistical Society published last week are particularly interesting in this respect. A group of 72 economists, drawn from a wide range of industrial and academic activities, were invited to give their opinon about the trend of economic affairs through 1956.

It is of interest that the average prognosis foresees the continuation of inflation, for it is expected that prices will rise faster than output. Along with this broad trend they expect, on the average, an expansion in industrial output of 2·9 per cent. in 1956 compared with 5 per cent. in 1955, and an advance in exports this year of 3·9 per cent. against 7 per cent. last year. In addition, they expect a slight rise in unemployment. They foresee a rather smaller increase in investment in capital equipment and a much smaller increase in the rate of accumulation of stocks.

Such a forecast is not particularly surprising to judge from the economic data available, but it is a striking contrast in some respects to the current official interpretation of economic trends. It is to be noted that there is no forecast of continued deflation neither is there any reference to a possibility of stable prices. If the professional economists' opinion is the correct one, the right prescription for 1956 should be for a mild attack of flatulence, not rest and quiet for a period of convalescence. The patient may be foregiven if he is somewhat non-plussed by the difference in the diagnosis. In so far as he is a trade unionist, of course, he is all for cure by self-indulgence —a forthright, simple but possibly dangerous prescription.

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Signs of a Trade Swing

On more than one occasion in the last 10 years the British external trade position has been saved by the down-turn in Commonwealth markets being offset by an increase in dollar exports or vice versa. This exercise in economic counterpoint has been particularly noticeable between the United States and Australia. In the last year or so the buoyancy of the United States market has taken much of the sting out of the Australian import cuts so far as this country is concerned.

It is an interesting speculation at the moment whether a change is coming. The trade boom in the United States is coming up against a serious decline in the output of automobiles. Automobile sales in 1956 are expected to be between 20 and 25 per cent. lower than in 1955. The fall is already expected to produce a decline in the U.S. steel production in the third quarter of this year.

It is much too soon to conclude that the American boom is over; the official view in the United States is that the forces making for expansion, notably the huge investment programme in new plant and equipment by major industries, are large enough to offset those making for decline. Nevertheless, a serious faltering in the production of automobiles in the United States has always in the past quickly transmitted its effects to industry in general.

In contrast there are signs that conditions in Australia are improving. Here again there are only straws in the wind. Wool prices have now been rising for about two months; and the sheep shearers' strike in Queensland is not the only factor in the situation. Australia's foreign trade balance also improved in May although there now seems little chance of achieving a balance on international account in the financial year which ends this month. A good deal of the Australian improvement has been due to the efforts made to keep down the upward trend of imports, but it cannot be overlooked that the value of exports in May was 32 per cent. higher than in May, 1955. It is becoming increasingly fashionable to emphasise the growing export potentials for Britain in the Western European market, compared with the Commonwealth. It is still not beyond the bounds of possibility, however, that after trade slackens in the United States it may be offset by better trading conditions with the Commonwealth. It has happened before.

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Treasure Island

The storm which blew up last week over the £63 million bid for the Trinidad Oil Company, Limited, by the Texas Company of the United States is to some extent the price of neglect. Economic penetration by the United States into the Caribbean area has been going on in a systematic way for many years. In contrast, this country has never systematically developed the West Indian market except for certain key commodities such as oil and sugar.

From the American point of view, the move is an astute one. Control of Trinidad Oil will at one stroke give the American company a bigger interest in the United Kingdom refined oil market through an increased holding in the Regent Oil Company. In addition, control of Trinidad Oil will give the Americans increased control over a Caribbean oil installation and also over oil developments in Western Canada where Trinidad Oil has an interest in Regent Refinery.

An effort was made in the company's memorandum and articles of association to preserve control of the board to British subjects. No change in the articles of association can be made without consent of the Governor of Trinidad. In addition, the domicile of the company could not be altered from the United Kingdom without Treasury permission under the Income Tax Act of 1952. It is quite clear that strong prejudice against the transfer of control from British to American hands has already developed in Parliament and elsewhere. It will be a nice decision for the Treasury and the Colonial Office to decide whether the political disadvantages of American control shall over-ride the principle that international investment has to be encouraged not only from east to west but also from west to east.

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Vacation Work for Students

The considerable increase in the numbers of young people who enter universities and colleges for higher education in technology is creating a major problem: how can they earn sufficient during their holidays to maintain themselves in reasonable comfort during term? Washing dishes in the winter and agricultural work in the summer may not be the best means of obtaining valuable experience, or for that matter very rewarding work. Considerable efforts are therefore being made to find students temporary posts in industry, doing work related to their studies and giving practical experience which will be valuable when they seek employment.

Very useful work to this end has been accomplished by the International Association for the Exchange of Students for Technical Experience (IAESTE). Last year this organisation (founded in 1948), successfully exchanged over 5,000

students, an increase of 17 per cent. on the previous year. Germany both supplied and accepted the highest number (over one-fifth of the total). Sweden accepted nearly as many (1,037) but supplied far less, in accordance with its relatively small industrial population. This country did not show up at all well by comparison, supplying 644 and taking 728. The secretary of the IAESTE branch in this country, Mr. J. Newby, is Superintendent of Vacation Studies, Imperial College of Science and Technology. In the year ending October, 1955, the number of students taking advantage of the vacation work scheme run by Imperial College totalled 517, compared to 479 the previous year. Some 250 concerns participated and received students during last summer.

With the approach of the summer vacation it is not amiss to point out that the number of companies participating is still very small While many students may prefer, or can afford, not to take on paid work in their holidays there is no question that they can benefit immensely from the scheme. It is general practice in the United States and is likely to become much more necessary in this country as the number of college and university students increases.

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Viscount into Vanguard

Large claims are made for the Vickers Vanguard turbo-prop air-liner. It has been planned to carry 115 passengers at a speed up to 425 m.p.h., combining route and load adaptability which should enable it to earn a profit for almost all major airline operating organisations. Recent announcements by B.O.A.C. have shown the fluctuations in revenue which can result from the problem of seasonal passenger loads. Vickers-Armstrongs (Aircraft) Limited have planned an aircraft which is expected to carry a full payload on stage lengths up to 2,000 miles. Being double-decked, it has a large freight capacity which will increase its loading flexibility. The Vanguard is due to fly in autumn, 1958, having been built on production jigs and not as a prototype. It will be owned by Vickers and will be retained for tests and demonstration purposes. It will be powered by four Rolls-Royce Tyne engines and the cruising speed is expected to be increased from 400 to 425 miles an hour between 1959 and 1963. First deliveries to B.E.A. are due in the spring of 1960.

By the time this machine flies it will have over one million hours of route flying by the Viscount behind it. In a sense, therefore, its evolution will have been different from the Britannia and the Comet. In each case these aircraft, at least so far as early marks are concerned, had to be evolved from the drawing board through to production via a prototype—as was the case with the Viscount. The Vanguard will be the first turbo-prop commercial air-liner based on a highly successful production predecessor. It will have much to live up to as the stable companion of the Viscount.

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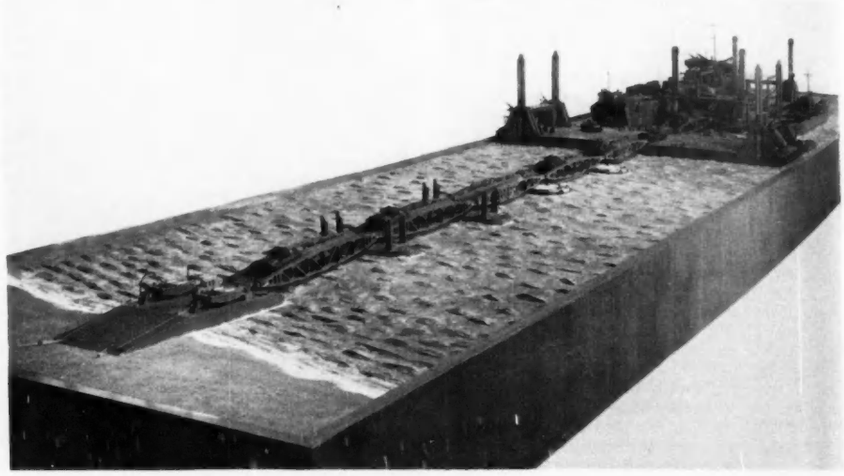
Mulberry Harbour Models

Last week, on Wednesday, June 6, just twelve years after the invasion of the Continent by the British and American Forces, scale models of Mulberry Harbour were unveiled at the Arromanches Memorial Museum on the seafront above the Normandy beaches. Mulberry, it will be remembered, was the code name given to the two prefabricated harbours, each the size of Dover, built in and around British ports and then towed under escort across the English Channel to provide a system of off-shore piers where tens of thousands of tons of supplies were to be landed each day.

Though these harbours were planned in their final form at the Quebec conference of 1943 it is interesting to recall that the execution of this enormous and intricate engineering feat was initiated by Sir Winston Churchill who, in a brief memorandum to the Chief of Combined Operations, asked for an investigation into the design of portable piers for use in landing operations. In a curt postcript he added: "They must float up and down with the tide. The anchor problem must be mastered. Let me have the best solution worked out . . . Don't argue the matter. The difficulties will argue for themselves." Of the two ports originally built, that intended for the American sector was largely destroyed by gales during the Channel crossing and had to be abandoned, but the contribution of the British port, Mulberry B, at Arromanches has been described as one of the most important tactical and technical developments of the war and of a significance matching only the scale of the invasion itself.



One of the five models of Mulberry Harbour at Arromanches Memorial Museum.

The display at the Arromanches Museum comprises five models representing the principal units and features of the harbour, and one of these models is shown in the illustration on this page. The whole display, which occupies an area of 75 ft. by 10 ft., was made by the model makers, Bassett-Lowke Limited, Northampton, and took more than 18,000 man-hours to complete. The cost of the models has been borne by the Arromanches Museum Committee assisted by a contribution made jointly by the British Constructional Steel Association and the Federation of Civil Engineering Contractors, whose members were so intimately connected with the original construction work.

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Base Metals on a New Tack

It is beginning to look as though the non-ferrous metals are having to adjust themselves to new basic market conditions. The strong upward tendency of copper prices (and of all the other non-ferrous metals as well) was sustained mainly on the purchasing activities of the U.S. stock-piling authorities and the U.S. boom. The industrial prosperity of Westen Europe has, of course, played a part but it's marginal influence on the market is less than that of the United States' industry. The days of stock-piling are numbered and the trend of output in the U.S. automobile industry presages a change of trend in U.S. business activity.

Copper prices have been weakening for some time, but there is plenty of evidence that the high levels reached in 1955 have done serious damage to copper's long-term prospects. The chairman of Enfield Cables Limited and the chairman of Aberdare Cables (Holdings) Limited have both pointed out the readiness of their respective companies to supply aluminium instead of copper sheathing. The Rhodesian Selection Trust Companies recently reduced their price from £350 to £320 a ton for copper c.i.f. electro wire-bar basis, and thus effected the second price reduction in a month although at this price they were still selling above the current price on the London Metal Exchange. At £320 a ton, however, the R.S.T. price is still well above the £280 a ton recently given by the chairman of R.S.T. as a good price for the copper companies and one which would discourage substitution of other base metals.

The movements of other base metals, such as lead and zinc, have been less spectacular and prices have been sustained up to the present by purchases for the U.S. stock pile. The recent trend of automobile output in America, however, has already begun to impart a certain nervousness to this market and it is likely that it will take a sudden increase in American industrial activity to reverse the downward trend in base metals.

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Calcium Carbide

First produced commercially for the manufacture of acetylene for lighting, calcium carbide is now an important industrial material. Production capacity in the United States is about 1¼ million tons per annum and in the world as a whole probably about two million tons. About one-third of the total consumption is used for the production of acetylene for metal cutting and welding but in recent years there has been a rapid growth in the use of acetylene as a raw material in the chemical and plastics industries. For example, in the U.S.A. about 20 per cent. of the consumption of calcium carbide is accounted for by production of acetic acid, acetaldehyde, polyvinyl acetate and vinyl acetate monomers, while a similar quantity is used for the production of vinyl- and vinylidene-chloride. Other important uses include various chlorine derivatives such as trichloroethylene, which are used as non-inflammable solvents for many purposes, while acetylene is also the starting point for the chloroprene-type synthetic rubbers.

Hitherto calcium carbide has been produced by the electro-thermal process, and production has therefore been largely confined to localities where there is a large production of cheap hydro-electric power. The Badische Anilin-und-Soda-Fabrik is, however, operating an experimental oxy-thermal plant at Ludwigshafen with a capacity of 70 tons per day. In this process coke and lime are charged into a special furnace provided with an oxygen feed. The necessary heat is generated by the combustion of part of the coke, and liquid carbide is tapped off periodically. It is claimed that this process turns out a higher concentration carbide than can be obtained in electric furnaces and that with the growing availability of tonnage oxygen it opens the way to the economic production of carbide in areas without cheap electric power.

Standards and Standards Officers

The recent meeting in London of 120 executives whose job it is to apply standards on the factory floor provides a good opportunity to take stock. The meeting was addressed by Professor H. W. Martin, an American standardisation consultant.

One of the lessons of the meeting was that standardisation tends to mean not quite the same thing in this country as it does in the United States. There, it has primarily economic significance. The adoption of standards by a company is designed to lower the cost of making a product, or a range of products, and to lower the cost of maintaining them. Mis-interpretation of the word "standards" abounds in the older industrialised countries. One commonly put forward is that to adopt standards is to opt for uniform dullness, to introduce rigidity and to throttle progress. Yet it is in those countries where the greatest industrial advances have been made—the United States and the Soviet Union—that standards are most widely adopted. The vital message of Professor Martin was that, to be successful, standards officers must concern themselves with "the eventual profit and loss account" in every move they make to achieve simplification of their companies' products.

The economic significance of introducing standards is probably what is appreciated least by the British Standards Institution as well as by industry at large. A delegate from the iron and steel industry complained that there were too many existing standards for steel. A representative of a chemical firm wanted more standards, not for his company's end products but for the materials they bought. This is also true of the engineering industry, but in its case a very energetic lead is given by the Engineering Equipment Users' Association (ENGINEERING, March 4, 1955). The standards this Association evolves are frequently taken up by the B.S.I., who now have over 3,000 standards in existence. The main obstacle to the extension of the work done by B.S.I. is that it requires the voluntary agreement of makers and users. In this context it is appropriate to mention the large motor manufacturer (a managing director) who, told that one of the vital components in his engine was being considered for a British standard, said "if they make it the standard, I'll damn well change the design." This attitude goes far to explain why the extension of B.S.I.'s work is difficult and slow. Of necessity they have to await agreements within industries, and these can take years to reach.

The work of B.S.I. and the applications of standards in industry were the subjects of two broadsheets published by P.E.P. (Political and Economic Planning) in July last year which are probably the best general review of the situation. Their comment on overseas standards provides a good ending for this note:

"With the growing adoption of standards overseas, the B.S.I. must increasingly turn its attention to the problem of securing international agreement, aligning British standards to requirements of overseas customers, and promoting British Standards in other countries."

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Public Health Courses and University Entry

It is probably in the form of post-graduate courses taken three or four years after original graduation that the potential engineer can best assimilate advanced knowledge of a specialist form. It is then that the fundamental knowledge acquired for a first degree is still familiar and some experience in the professional world will have given some point to further studies. It is probable, moreover, that only at a university can the more recent advances be studied and there the engineer is not harrassed by the day-to-day detail that is normally associated with professional work.

It is therefore disturbing to learn that some post-graduate courses are not being taken up by the full number of students that can be accommodated or, as is more frequently the case, overseas students are being accepted in the absence of applications from British students. Such an instance has recently come to our notice in respect of the post-graduate course in Public Health Engineering at King's College, University of Durham. There, in 1950, the Department of Civil Engineering instituted a one-year course which was to be run in two parallel sections: one appropriate to temperate zones and the other suited to public health conditions to be found in the tropics.

There has been an almost complete lack of applicants from these islands, though there has been no shortage of overseas students so that the tropics course has become of greater significance. This can be attributed to the fact that many of the overseas students are seconded specially by their Governments or by professional organisations to go to Newcastle for the course; but it is still hoped that men from the United Kingdom will take advantage of the facilities that are available there.

In contrast to the experience at Newcastle, however, it is to be noted that the corresponding course at a London college has had a full complement of students during the past year and has received more applications than there are places available in respect of the year commencing October. Moreover, during the past year, all the students were from the United Kingdom and even next year only two will be from overseas.

This difference in the number of applications being made by British post-graduate students to these particular courses at Newcastle and London would appear to be in keeping with the experience of university engineering departments in respect of undergraduate entry. A cursory survey appears to show that whereas universities in the south, London, Southampton and Bristol, have received applications for seven or even ten times the number of engineering places available, a very different state of affairs exists in the northern universities. Indeed, the further north one goes the smaller are the number of applications being received, so that at some Scottish universities there is even a possibility that all the available places will not be filled next year.

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B.M.C's New Small Bus

Almost every week now brings news of new or improved models from the British motor industry to meet the increasingly keen competition in export markets. From the British Motor Corporation comes a new range of light commercial vehicles including a light 10-seater forward control bus—a type hitherto rather neglected by the British industry. By omitting the transverse seats and putting two bench-type seats along the sides for the home market, the seating capacity can be raised to 13, and the buyer saves £313 in purchase tax.

The range also includes a light van and pick-up truck, all using the same basic unit structure, and will be sold with different radiator grilles through Morris and Austin dealers. The van has sliding side doors to permit use in confined spaces. The pick-up is loaded via a dropping tail board, secured by chains which are plastic-covered to prevent rattle. The bus has two side doors at the forward end, one midway, and another at the back. Driver and front passenger sit each side of the engine housing, which is set back slightly to permit access to the driving seat from either side. The cowl top is double skinned and cool air circulates through it from an intake alongside the radiator. Behind the front seats on van and bus is a transverse bulkhead rising to waist level, separating the driving compartment from the rest of the vehicle, and adding torsional strength to the structure.

The engine is the B.M.C. four-cylinder B-type of 1,489 c.c., held down to 42 b.h.p. at 4,000 r.p.m. in the interests of durability. Transmission is through a four-speed gearbox with steering column control to a normal hypoid rear axle. Suspension at front and rear is by rigid axles and half-elliptic springs, the shackles being attached to box-section reinforcements which run from front to rear under the floor.

Absolute Reliability

The announcement by the Battelle Institute that they are putting in hand a programme of tests on electronic components, to judge their reliability, underlines one of the needs of the present day, namely that mechanisms can be trusted. With the growth of automation even in its simplest forms, absolute reliability of the controlling apparatus is required.

For many years, long-term tests have been carried out on the reliability of components, with the result that modern equipment can now run in safety without attention for very long periods. Much work was carried out during the last war on this matter, as here again absolute reliability was a vital necessity. The work is necessarily tedious and most of it is unspectacular; many hundreds of components may have to be tested for long periods in order to acquire results of statistical significance. In some of the more complex electronic devices an average component failure rate as low as one in 10,000 in the course of 10,000 hours' operation may be far too high. Obviously statistics of this sort are difficult to obtain, especially as accelerated tests gave doubtful validity. The more laboratories there are working in this field the more rapidly will useful results be obtained, and industry as a whole will benefit. In this country, work is being carried out on quite a large scale by the Radar Research Establishment and the Royal Aircraft Establishment and, on a smaller scale, at the Atomic Energy Research Establishment, to mention only the section of research under Government auspices.

Manufacturers, too, have their own test departments where new components can be tried before they are finally approved, not only for performance characteristics but also for this important point of reliability. Though perhaps the need for perfect service from instruments is more obvious during a war, none the less much time can be lost, and possibly considerable damage caused, by failure of an instrument governing some automatic or semi-automatic process.

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Rocket Research

The Rocket Propulsion Department of the Royal Aircraft Establishment at Westcott, Buckinghamshire, opened its gates recently to allow Press representatives to obtain a brief glimpse of its activities. Here are carried out development work and static tests on rocket engines, both of the liquid and solid-propellant types, and fundamental research on problems associated with them. The solid-fuel rocket, simpler and safer to handle, and more efficient for very short durations, is universally used for "boost" motors; the liquid-fuel rocket comes into its own at longer durations and is therefore more suitable for long sustained missile flights and for aircraft applications.

Most of the test cells for solid-propellant rockets are simple in character, made up of sheet piling protected by earth embankments. A more elaborate cylindrical cell is arranged for testing combustion chambers and complete liquid-propellant rocket engines, firing horizontally, with separate concrete chambers housing storage tanks for high-test peroxide and kerosine, with an underground control room from which the tests are conducted. A vertical-firing rig is at present being modified to accommodate engines developing more than 20,000 lb.-thrust. One of the facilities at Westcott is a large cold store with an outer drying chamber and three inner chambers maintained at temperatures of −20 deg. C., −40 deg. C. and −70 deg. C., for storing rockets and materials to prove their ability to withstand low temperatures.

Among the demonstrations was the test-firing of a solid-propellant Mayfly boost motor developing a thrust of 18,000 lb. with an endurance of about 2·7 sec. The charge is of hollow cordite, burning taking place down the central tube, so that the charge itself serves to insulate the combustion chamber from the flame; thus it is

possible to salvage these casings for re-use, since the temperature they attain does not exceed 200 deg. C., although the burning temperature is 10 times that level. During test firings, records are taken of thrust and chamber pressure versus time.

An interesting solid rocket under development there is the Raven which is to power a high-altitude research vehicle for the International Geophysical Year. This rocket, with a thrust of 11,500 lb. and a burning time of 30 sec., is designed to reach an altitude of 100 miles.

Problems in the liquid-propellant field include the development of compact high-performance turbo-pumps for feeding the propellants; the difficulty of providing effective fluid seals has been overcome by the development of a rotary seal. Non-spill self-sealing pipe couplings have also been developed, and work is in progress on corrosion-resistant hoses and sealants for low-temperature use.

Certain ceramics have now been developed with reasonable thermal-shock properties. For example, hot pressings of molybdenum and zirconium carbides have been found to withstand really high temperatures. Other aspects of the work of the Combustion and Materials Department includes the routine testing of propellants in storage; research on propellants and catalysts; metallurgical examination of failed engines; and fundamental research on combustion—since hitherto most existing work on this subject has been confined to flames in air.

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The Wagon of the Future?

The results of a competition initiated two years ago for a design of " the standard wagon of the future " were announced last week by the sponsors, the Office for Research and Equipments (ORE) of the International Union of Railways (UIC), whose headquarters are at Utrecht. The starting point of the competition was the assumption that European railways can no longer afford to be conservative in their ideas on the technical construction of wagons and that there is much to be gained from the building up of a homogeneous " European " stock from standard designs.

For some time, ORE have studied the standardisation of wagons. One of their 13 specialist committees (which comprise in all about 100 specialists from 15 different countries, engaged on 13 investigations on the ORE programme) reported on this work in the second issue of the ORE Bulletin, that for December, 1954. Unfortunately, the English edition has only recently become available. So far six types of standard wagons have been built. All types—covered van, open, flat with folding stanchions, flat bogie and heavily insulated refrigeration van—are designed to ensure interchangeability of replacement parts most frequently used in international traffic. The full materials and construction specifications are therefore given in the committee's report. The competition for the wagon of the future was governed by four main conditions, in order of importance: (1) reduction of the annual capital cost averaged over estimated life and reduction of the annual cost of maintenance; (2) reduction of operating costs, e.g. economies in motive power made possible by reduction of the wagon tare or by a reduction of costs for running repairs; (3) reduction of life (now 40 to 50 years) in order to make possible an accelerated rate of modernisation; and (4) other advantages, such as more efficient, or safer, carriage of goods.

Nineteen firms, from six different countries, entered the competition, which was won by Waggonfabrik Uerdingen A.G., Krefeld Uerdingen. Second and third places were taken by French firms, Etablissements Industriels Soulé, Bagnères-de-Bigorre, and Etablissements Arbel, Paris. These three received prizes of 60,000, 25,000 and 10,000 guilders respectively. Bonus prizes were won by one German concern (M.A.N.) one French, one Belgium and one Swedish. As all entries were strictly anonymous it is not possible to say whether British firms entered, though it seems unlikely.

This original and enterprising manner of stimulating fresh thought on railway equipment would seem to be very sound practice. Now ORE are busy investigating with railway organisations how the results of the competition can be applied. It is hoped that British Railways, who are members of both UIC and ORE will be able to benefit from any real advances that are made in railway practice.

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Iron and Steel Institute in France

The special meeting of the Iron and Steel Institute, held in France, from June 5 to 14, at the invitation of the Chambre Syndicale de la Sidérurgie Française and the Société Française de Metallurgie, opened with a reception held at the Chambre de Commerce de Paris, in the Avenue Friedland, near the Place de l'Etoile. Following a steamer trip on the Seine, the first session of the meeting, a plenary one, opened in the Grand Amphithéâtre de la Sorbonne, University of Paris, in the afternoon.

The session was presided over by Mr. Jean Raty, President of the Chambre Syndicale de la Sidérurgie Française, who welcomed the guests. In returning thanks, Dr. H. H. Burton, C.B.E., President of the Iron and Steel Institute, announced that Mr. Raty and Mr. Henri Malcor, President of the Institut de Recherches de la Sidérurgie (IRSID) had been elected honorary members of the Institute and that Mr. Eugenè Dupuy, President of our contemporary, the *Revue de Métallurgie* and Baron Walckenaer, President of the Société Française de Métallurgie had been elected honorary vice-presidents. Subsequently it was announced that Dr. H. H. Burton and Mr. K. Headlam-Morley, the President and secretary, respectively, of the Iron and Steel Institute, had been made honorary members of the Société Française de Métallurgie.

After an introductory speech by Mr. Marcel Fourment, President of the Société des Ingénieurs Civils de France, Mr. Georges Delbart, scientific director of IRSID, delivered a lecture to comemorate the centenary of the invention of the Bessemer process. In the course of this, he stressed the independent outlook of Bessemer and his many inventions connected with many industries. He then traced the progress of the Bessemer process and added that although it was now 100 years old the procedure carried on at the present time did not differ markedly from that originally adopted.

In the evening a reception was held at the Louvre by invitation of the Chambre Syndicale de la Sidérurgie Française and the Société Française de Métallurgie.

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Gear Tooth Design

The papers presented at the six-monthly meetings of the British Gear Manufacturers Association are usually of considerable interest to all those interested in gear design. The paper read on May 15 by Mr. W. J. Davies, chief transmission engineer, Aero Division, Rolls-Royce Limited, entitled " Some Aspects of the Loading of Gears and Rolling Bearings," is no exception. He has set himself the task of reviewing recent research work in the light of his firm's experience, and by doing so he arrives at suitable design criteria for tooth failure due to fracture, pitting and scuffing. The results must be of great interest to any gear designer, and may well be of considerable stimulus to some. Of his various proposals for gear tooth design criteria, his scuffing criterion is the one most likely to cause interest, and to cause designers to search through their own records. Regarding scuffing as being essentially a welding process, he proceeds to multiply the instantaneous temperature rise (Blok's criterion) by the Hertzian pressure to obtain his own criterion.

It would be unfair to Mr. Davies to quote his various fomulae in detail, since he himself is the first to point out that " there are numerous such in existence, and the majority probably serve fairly, provided that their use is tempered with intelligent appreciation of their limitations and empiricisms." Unless a designer has followed the arguments which Mr. Davies has used, he will be unwise to try to apply or judge the worth of the formulae. Since the paper is non-mathematical in its form, there is no excuse for not reading it, except that to do so may shatter a number of comfortable illusions.

Two serious criticisms may be made of this paper. Firstly, Mr. Davies has apparently failed to realise the importance of Mr. S. L. Harris's contribution to the discussion of Jacobson's recent paper to the Institution of Mechanical Engineers (*Proc. I. Mech. E.*, vol. 169, no. 33, page 602) in which dynamic tooth loading is discussed; despite statements made in the reply to the discussion, very similar results have been obtained with an entirely different technique using steel gears by Niemann and his co-workers (recent unpublished doctor's thesis). Secondly, he never discusses the work of Niemann and his colleagues, except for two minor references. Most of this work is readily accessible, and since some of it conflicts with other work on which Mr. Davies relies, it would be interesting to know why he has neglected it.

Copies of Mr. Davies' paper may be obtained from the British Gear Manufacturers Association, 301 Glossop-road, Sheffield 10.

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Stronger Die Blocks for Forging

The Heppenstall Company of Pittsburgh, U.S.A., have been for many years one of the leading makers of die blocks. William Jessop and Sons, Limited, Brightside Works, Sheffield, are now producing blocks to the Heppenstall technique, which requires carefully-controlled analysis and stringent control in manufacture.

After being cast into ingot form, the steel is forged into a bloom, the size depending upon the dimensions of the finished block. A reduction of at least 3 to 1 in cross-sectional area is achieved at this stage. From the bloom a suitable length is cut and upset-forged, reducing its length and minimising the directional properties associated with the original ingot. The block is forged on all six faces to further this end and to produce fully square corners. The uniformity of the die-block material is important since service stresses are of a tri-axial nature. Following the forging operation, the blocks, while still hot, are thermally treated to remove stresses and any tendency to internal defects.

" Hardtem " die blocks, as they are termed, are available in the hardened condition so that after cutting the impression, further treatment is unnecessary. This means that the die is neither scaled or decarburised. Differences in hardness are, however, possible and desirable. Small blocks for the production of thin stampings and moderately-deep impressions sunk in large block masses can accommodate higher levels of hardness than deep intricate impressions. There are therefore four levels of hardness.

When a die block is in use, the bursting stressing is considerable, particularly when the impression is deep. On account of this it is imperative that the steel be sound and quite free from internal defects which would act as " stress raisers." To ensure this, all Hardtem blocks are examined by means of ultrasonic equipment and the top face is machined so that the examination may be accurately carried out.

One final point concerns the direction of grain flow, which is usually more strongly marked in the direction of the original ingot longitudinal axis, although thorough forging minimises this effect. So that the die sinker can choose the direction of the grain relative to the impression, the axis of major grain flow is indicated on the blocks by a stamp mark. This feature is particularly valuable in the case of square blocks.

ENGINEERING IN SCOTLAND—2

This is the second of three articles on some typical Scottish engineering firms and their products. The first article, which appeared in our issue of June 8, page 461, dealt with John Hastie and Company, Limited (ships' steering gear), and Weir Valves, Limited (heavy-duty valves). The third article will include Yarrow and Company, Limited, and Scottish Mechanical Light Industries, Limited. It will appear in a subsequent issue this month.

WIRE ROPES

A firm specialising almost entirely in the manufacture of wire ropes is Martin, Black and Company (Wire Ropes), Limited, of Coatbridge, Lanarkshire. Founded in 1933, this company gradually increased its production in spite of raw-material difficulties until 1937 when this problem was finally solved by the formation of an associate, the Speedwell Wire Company, Limited, which has since then produced the wire necessary for rope manufacture. To-day, the company is making a wide variety of ropes, ranging in circumference from a quarter of an inch to 10½ inches. The following account gives the company's background and outlines the way in which wire rope is made; the "Gyrac" rubberised haulage roller is also described.

After the war, during which the company was engaged on defence work, Martin, Black undertook an expansion programme, and the works were completely modernised and re-equipped at a cost of over £100,000. The present number of employees is 300, and production has increased to such an extent that last year it was 15 times the volume and 45 times the value of the 1934 output. The firm's largest export market is Canada where the wire rope is used in the mining, oil and marine industries, and a new trading company has been formed there to represent the parent organisation. Other applications are in the building, contracting, engineering, fishing, timber and aircraft industries. Among the ships that have employed Martin, Black ropes are the Queen Elizabeth, the Saxonia, the Royal Yacht and the Empress of Britain.

The expansion programme which was carried out after the war was designed to achieve continuous production with the minimum of handling, and entailed considerable re-grouping of the machinery. Closing machines were more widely spaced, and the splicing, dispatch and cutting departments were re-housed in a new building constructed for that purpose. At the same time the capacity of the works was substantially increased, and the ropery converted to a planned system of production closely co-ordinated to the output of the wire mill. Co-operation between the Speedwell Wire Company and the Martin, Black works enabled the wire to be brought from the mill to the ropery on the appropriate bobbin. This was effected on spooling machines, and eliminated 90 per cent. of the rewinding which had previously been necessary.

LUBRICANT IMPREGNATING PLANT

Other features of the layout, which has only recently been completed, include modern tubular stranding machines which permit faster and more efficient working, giving an almost doubled potential output. A batch of "snake" stranding machines are illustrated in Fig. 8. Another improvement has been the installation of an unusual impregnating plant at the ropery, which has made it possible to satisfy individual requirements in lubrication. All the fibre cores used in the manufacture of the wire ropes are of course bought in dry. Considerable pains are taken in the protection and packing of rope prior to dispatch, and cleanliness and improved working conditions are notable features of the workshops.

The character of a wire rope necessarily depends to a great extent on the wire from which it is made. Modern practice in wiredrawing produces wire of last as much as three times as long as 110 to 120 ton ropes. A view of the company's wire-drawing plant is given in Fig. 9.

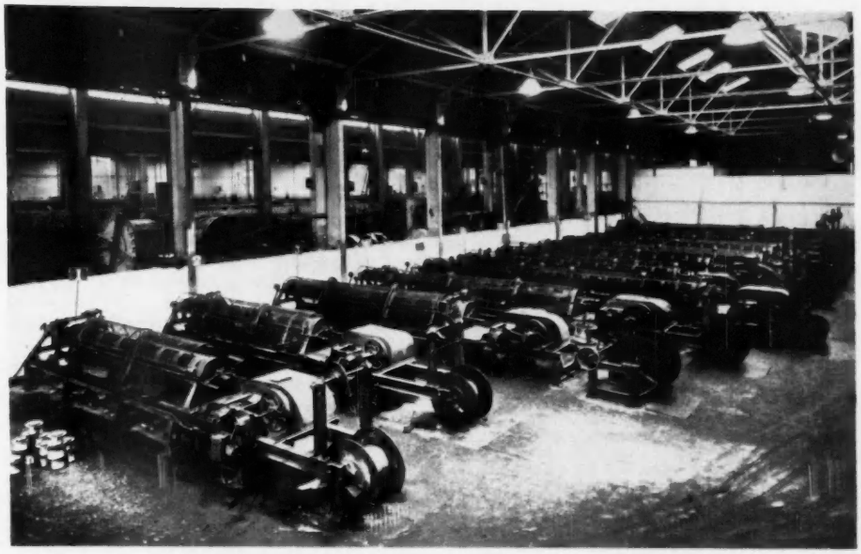

Fig. 8 A batch of small "snake" stranding machines for wire-rope making installed on the premises of Martin, Black and Company (Wire Ropes), Limited.

CHOOSING A ROPE

There are two principal features of rope construction: the grouping of wires to form single strands and the laying together of strands to form the completed wire rope.

In choosing a wire rope, several factors have to be considered: (*a*) the degree of flexibility specified; (*b*) the extent to which the rope will be subject to abrasive wear; (*c*) the manner in which it is to be secured (free to rotate or both ends anchored); (*d*) its capacity for resisting twist; (*e*) its ability to withstand heavy lateral pressure at deflection points; up to 125 tons per square inch tensile strength with a remarkably high degree of ductility, and the resulting rope has high breaking strain for small rope size and general freedom from brittleness, making it suitable for most purposes. However, there are applications for which high-tensile wire would not be selected since, as the carbon content of the steel is raised, the rate of work hardening due to cold working increases, and repeated flexing over pulleys causes embrittlement to take place more rapidly than with lower tensile steels.

Thus it has been found that for general engineering purposes "best plough steel" having a tensile strength of 100 to 110 tons per square inch is suitable; the most economical choice for excavator and earth moving ropes is "improved plough steel" of 110 to 120 tons per square inch; and for lift ropes "patent steel" with a tensile strength not exceeding 80 to 90 tons per square inch should be used except in special cases. Experience shows that lift ropes of 80 to 90 tons per square inch in normal installations (*f*) the strength per unit cross-sectional area required.

Factors (*a*) and (*b*) tend to conflict but both concern the segregation of strands into wires; to give flexibility the strands must be composed of many wires of small gauge but to resist abrasion the wires should be few and of large gauge. Thus for colliery haulage where abrasion is the main cause of failure 6/7 ropes (six strands of seven wires) are commonly used; for standing rigging too this construction is used but because its tough construction allows the minimum stretch under strain, thus dispensing with the need to tighten the rigging at intervals. At the other end of the scale is the 6/91 rope with 91 wires per strand, which is extremely flexible but unresistant to abrasion.

Strand formations of this kind, which may be known as "proportionate lay," are based on the geometrical fact that six circles fit round one circle of equal size and that by increasing the number of equal circles in each successive layer by six a perfect arrangement is obtained.

SEALE LAY

Among recent developments in rope design is the Seale-lay construction which has been introduced to meet the needs of modern machinery. In the formation already discussed, the lay pitch or length of twist is proportionate in each layer of wires so maintaining regularity, roundness and equality of wire length in each strand. This means, however, that wires lie crosswise on the crowns of wires in the preceding layers. By comparison, the wire layers in Seale-lay or equal-lay strands are each laid at the same lay pitch and all layers contain the same number of wires. Thus the outer wires lie in the grooves formed by the inner layer so that when the rope is subjected to heavy side pressure there is less danger of wires cross-cutting each other. In addition, since the outer wires are necessarily larger than the inner ones, they are better able to resist abrasion; flexibility is improved both by the smallness of the inner wires and by smoother relative movement within the strands than would be possible if the wires were cross laid.*

* A comparison of wire ropes of different lays under working conditions appears in ENGINEERING, vol. 180, page 44, 1955.

Fig. 9 View of wire-drawing department of the Speedwell Wire Company, Limited. The application of a given wire rope should determine the choice of construction and the nature of the constituent wires.

Seale lay has been successfully applied in passenger lifts operated by the V or traction sheave, in which the rope is gripped by means of a groove in a power pulley; and in earth-moving machinery where ropes are subjected to heavy shock loads. Variations on this and other lays are of course numerous.

One such variation is the flattened-strand rope, which has been devised to resist abrasive conditions. The separate strands are so pre-shaped that when they are laid together they give a smooth periphery to the rope, and consequently each strand presents three or four wires at the extreme circumference where the rope is most subject to wear. A minor feature of the flattened-strand rope is that it is more compact in construction with a greater proportion of steel in the cross-sectional area, so giving a slight increase in breaking strain. Among the wide diversity of flattened-strand constructions are ropes with strands of triangular, oval and tape-like cross-section. Flattened-strand ropes find their greatest application in mining but they also have uses in general engineering and shipping.

UNTWISTING AND PRE-FORMING

Non-twisting ropes as may be required for cranes and mine-shaft sinking, are made up with two or more layers of small strands, each layer being laid in the opposite direction to its predecessor. The untwisting tendencies of the various layers thus nullify each other. Such ropes are generally constructed from 17 strands of 7 wires each, laid 11 strands over 6 strands over fibre core, or from 34 strands of 7 wires, laid 17 × 11 × 6 × fibre core.

Steel wire rope of most constructions can be fabricated in two ways—in ordinary lay and Lang's lay. Ordinary lay ropes have the wires in the strands laid in the opposite directions to the lay of the strands; in Lang's lay both are laid in the same direction. Lang's lay ropes flex more easily and wear better, but their application is restricted, for twist induced by tension does not revert on release as in an ordinary lay rope; hence it should not be used where rotation can occur. However, where both ends are fixed as in colliery winding ropes using wooden or rail guides and passenger lifts and in endless haulage ropes, Lang's lay can be used successfully.

Pre-forming has also been widely employed in recent years. Pre-formed ropes have their component wires and strands shaped in advance to the helix they will assume in the rope. In this way the inherent tendency to untwist is reduced; unnecessary stresses are relieved; fatigue can be withstood for a longer period; ropes can be cut without previous binding; and handling is much simplified since kinking and twisting are minimised.

Wire-rope cores are generally made of fibrous rope and this can be divided into two main groups: hard fibre such as sisal or manilla and soft fibre like jute. Ropes for heavy duties or wet working conditions usually contain hard fibre, which does not readily take up moisture; soft fibre has the capacity to absorb considerable lubricant prior to manufacture thus adding to the corrosion resistance of the wire rope. All-wire cores are normally used for service at high temperatures or to resist the effects of crushing as in excavator rope. Lubricants and preservatives are applied in accordance with the conditions in which a given rope is to be employed.

RUBBERISED ROLLERS

To assist in extending the life of wire ropes, Martin, Black and Company have developed the haulage roller with replaceable rubber sleeves shown in Fig. 10. Known as the "Gyrac" rubberised roller, it comprises two tapered barrels cast in aluminium—one male and one female—with retaining flanges on their outer edges; on assembly the two sections are compressed together by three Naval-brass studs

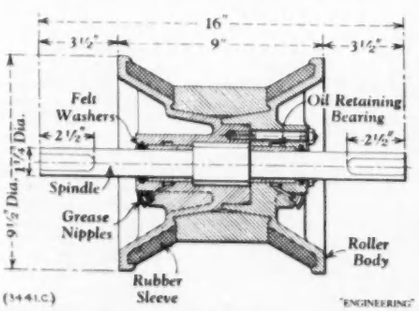

Fig. 10 To assist in extending the life of wire ropes, Martin, Black and Company have developed the "Gyrac" rubberised haulage roller, the rubber sleeves of which can be replaced.

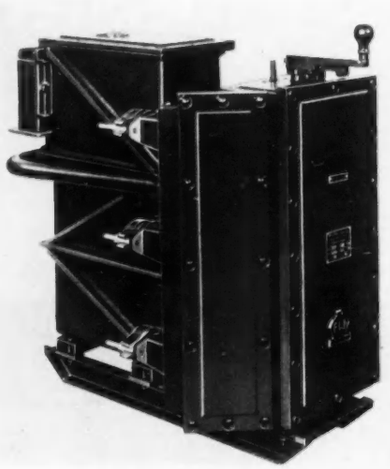

Fig. 11 Combined controller and resistance unit made by W. and H. Nelson Limited. It incorporates a drum-type air-break reversing controller and is suitable for use on alternating-current supplies up to 660 volts.

and nuts with lock washers. The barrel and tapered flanges are covered by three rubber sleeves, the centre sleeve being cylindrical and the two outer sleeves near conical. Compression is imposed on the sleeves by the retaining flanges during assembly. The spindle, which is made of mild steel, is of the stationary type; and Oilite self-lubricating bronze bearings maintain free running.

ELECTRICAL SWITCHGEAR

The county of Lanarkshire has long been associated with Scottish industrial development. Rich deposits of coal first brought industry to the district, and subsequently the Lanarkshire steel mills provided the basis for further growth. To-day the coal deposits have been virtually exhausted and the active coalfields are now farther east; but the industry has remained, serving to absorb labour released from the defunct mine workings. Though some firms which had originally produced equipment for the mining industry converted to other products, many have retained their links with coal mining. One of these is the company of W. and H. Nelson, Limited, of Nelbest Works, Mossend, Bellshill, Lanarkshire, who manufacture a wide range of electrical equipment mainly for use in mines, including a variety of flameproof switchgear.

Founded originally in 1925, as a firm of electrical contractors, the company assumed its present form some 25 years ago, since when it has continued to expand. The last war interrupted its development, but it nevertheless contributed extensively to the war effort, executing electrical work for the Admiralty, such as the manufacture of battery trays, and also undertaking the machining and drilling of tank armour plates. Following the war, Nelson's developed a complete range of flameproof and non-flameproof electrical equipment, including joint boxes, circuit breakers, controller and resistance units, motor starters and gate-end boxes; gear is also made in accordance with special requirements. The factory at Mossend is equipped for precision work and is engaged constantly on research and development.

In 1941, the Nelson brothers formed a company known as Redlac Limited, also situated at Bellshill, which is treated in a subsequent article. They now produce the casings for the Nelbest range of equipment and also manufacture independently a variety of prefabricated steelwork.

CONTROLLERS AND STARTERS

Among the principal products in the Nelbest range are the company's hand-operated controllers and resistances, which may be of crane of flameproof pattern or drip and dust-proof. A combined controller and resistance unit is shown in Fig. 11, and the interior of a typical drum controller in Fig. 12. The combined set, which is built for use on alternating-current supply up to 500 volts, is of all steel construction and incorporates a drum-type air-break reversing controller. The barrel and fingers are liberally rated to ensure high breaking capacity and contacts are fully accessible and easily renewed. Arc shields are provided on the stator contacts to prevent flashing over. Pawl roller action of the operating mechanism gives definite step location with easy movement of the control handle, which cannot be carried through since the system is interlocked. The cable glands are designed to suit S.W.A. or D.W.A. cable with or without lead sheathing. When mounted the combined equipment is 43 in. high and the resistance unit, the interior of which is assembled as a complete unit and is easily removed from the reinforced case, can be fitted horizontally or vertically.

The Nelbest air-break drum controllers may be employed with direct-current or alternating-current motors, and are intended for use in hoists, cranes and other forms of haulage equipment. They are made in three current ranges: 50 amps., 100 amps. and 150 amps.; and the alternating-current version can be designed to give normal stator and rotor control or rotor control only. The direct-current models

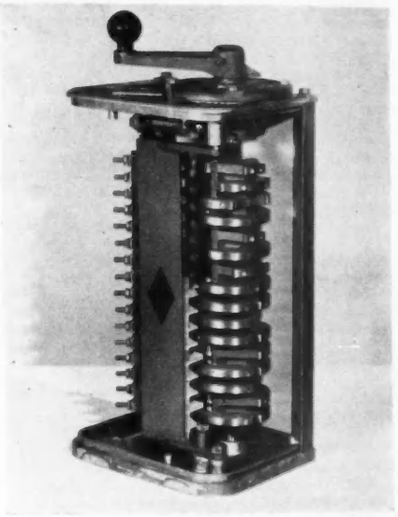

Fig. 12 Interior view of a Nelbest air-break drum controller. Units of this kind may be used to control alternating-current or direct-current motors and are suitable for cranes, hoists and haulage gear in mines, shipyards or engineering works.

may be arranged for series, shunt and compound motor control, including plain series and dynamic braking. Provision may be made for controllers to interlock with shunt and series limit switches, crane protective panels and circuit-breakers. Nelbest haulage controllers, which are made in both flameproof and non-flameproof forms, consist of a combined drum controller, back-up contactor panel with built-in isolating switches all mounted in a single case.

The company's range of automatic motor starting equipment comprises panels for direct-on, auto-transformer, star-delta stator rotor, and primary resistance units. These can be made as single units or switchboard assemblies and can be arranged for local or remote control with sequence operation. Safety and protective features include interlocks between front cover and isolating switch, and solenoid overload relays fitted to contactor starter and circuit-breaker units. Oil time lag of two-stage

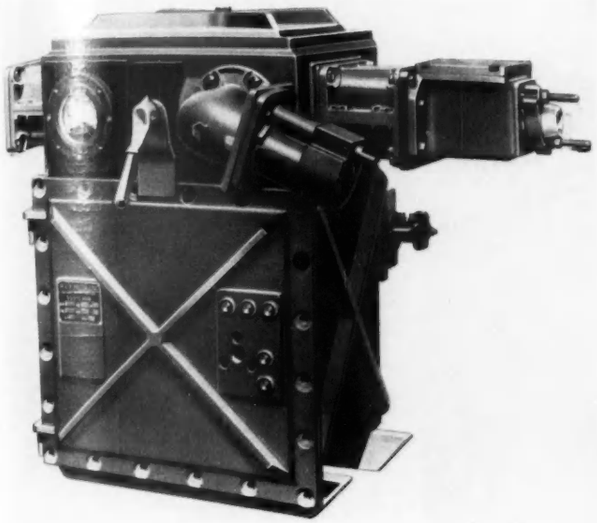

Fig. 13 Nelblest flameproof air-break gate-end box. It is a contactor-operated unit with an intrinsically safe remote-control circuit, and is designed for controlling a wide variety of portable equipment in mines.

protection to cover normal overload currents and peak starting currents; the settings vary between 100 per cent. and 200 per cent. full-load current, with inverse time delay characteristics.

FLAMEPROOF GEAR FOR MINES

A recent addition to the company's products is the flameproof gate-end box shown in Fig. 13, which is a contactor-operated unit with an intrinsically safe remote-control circuit. Known as the GEF/2 air-break electrically-operated gate-end box, it is a robust versatile unit designed for controlling a wide variety of portable equipment used in mines. The isolating switch can be arranged straight through, reversing, or on-off earth. The contactor is fitted with two-stage time-lagged overload relays and earth leakage protection is also provided. The unit is fully interlocked in accordance with B.S. specification and the main interior components are mounted on a frame and may be easily removed for inspection and maintenance. There are two versions: one suitable for 80 amps. and up to 660 volts alternating current; the other, which also operates up to 660 volts, can take a current of 150 amps.

Another new series of products are a range of flameproof start-stop push-button units. Nelson's also make flameproof double bell-pull switches, a 0·5 kVA transformer for mine signalling and lighting, and a comprehensive range of joint boxes for all types and sizes of cable, among which are telephone-cable link-type joint boxes in standard sizes from two-pair to sixty-pair cables. Electrical gear is also manufactured at the Nelbest Works for marine use and includes watertight control units for derrick and boat-lowering davit winches, and various kinds of hoist controls.

W. and H. Nelson have built a number of switchboard panels for the development areas of the National Coal Board and have installed a 24 unit switchboard control panel at Newton Brickworks in Lanarkshire—the first brickworks to be built by the N.C.B. In this plant extensive use has been made of remote control to reduce manual working. Nelbest flameproof equipment has been used for the overhead cranes at the Atomic Energy Research Establishment at Harwell.

STEEL FABRICATION

The company of Redlac Limited, situated at Bellshill, Lanarkshire, was formed as an associate of W. and H. Nelson, Limited (see previous article) in 1941. During its first years Redlac were employed on war production and specialised in the machining of steel plates for tanks and in the production of pontoon bridges. Since the war the firm have concentrated on fabricated steelwork, including the manufacture of casings for all Nelbest electrical equipment; they have also been responsible for making the McCormick Automatic Silk-Screen Printer.

Recently the original two bays of their premises have been converted into a machine shop and the sheet-metal and steel-fabricating departments housed in two new buildings. Redlac have executed a considerable quantity of prototype production for neighbouring firms and are specialists in both gas and electric welding. Their work for W. and H. Nelson involves the manufacture and machining of heavy reinforced casings for flameproof equipment and they have also co-operated in the development of the compact four-tiered control panels made by Nelson's and illustrated in Fig. 14.

SILK-SCREEN PRINTER

One of the most interesting products made by Redlac is the McCormick silk-screen printer, claimed to be the first automatic machine of its kind to come into world-wide use. There are three models being built at the Bellshill factory: the table model; the standard model, of which several hundreds have already been made; and the largest model, with an automatic take-off.

The company are also concerned in the field of colliery engineering. A short time ago they completed a prefabricated winding drum for Lochhead Colliery in Fife; the drum is shown in Fig. 15. The cheeks and barrel plates of the drum were made in four sections and the final weight of the drum, including the oak cleadings was about eight tons. The creeper structure for the pit bottom at this colliery was fabricated at the same time. Redlac are at present working on shaft furnishings in the new National Coal Board colliery at Bilston Glen, Midlothian.

QUARRYING INDUSTRY

The Engineering Division of Keir and Cawder Limited, which is situated at Kirkintilloch Road, Bishopbriggs, near Glasgow, is a post-war development of the firm, specialising in the construction of permanent and mobile quarrying and stone-crushing equipment. The Division has undergone considerable expansion since its formation. Keir and Cawder are active in most parts of the world and the Engineering Division's mobile crushing plants have been sent to the Gold Coast, the Belgian Congo, Malaya and other countries; their permanent plants have been installed in quarries throughout the United Kingdom and abroad. In keeping with the modern trend of storing mining waste in exhausted coal seams, they have also built several large crushing plants for processing waste. Fig. 16 shows a 280 tons per hour rubbish processing plant at Nantgarw Colliery.

The Division are also responsible for producing

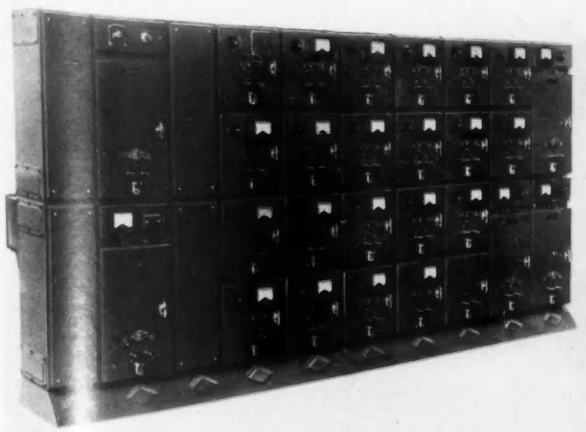

Fig. 14 Four-tiered control panel made by Redlac Limited for W. and H. Nelson Limited, with which company they are associated. They also manufacture and machine the heavy reinforced casings for Nelbest flameproof electrical equipment.

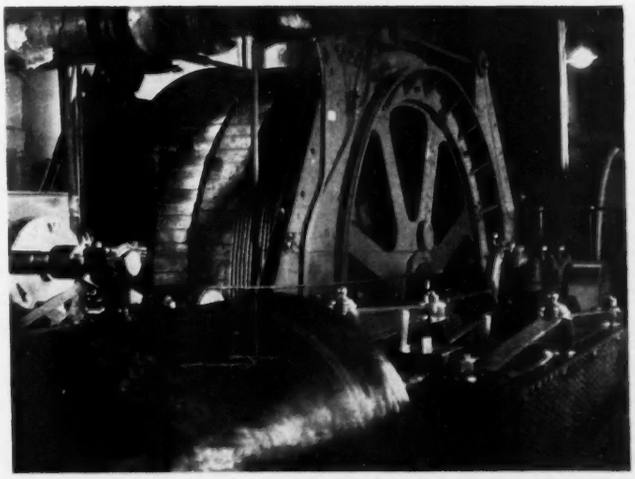

Fig. 15 Redlac are mainly engaged on steel fabrication work and the prefabricated winding drum shown here has recently been made for Lochhead Colliery in Fife. They also produce the McCormick Automatic Silk-Screen Printer.

Fig. 16 Rubbish processing plant for Nantgarw Colliery with a capacity of 280 tons per hour designed and built by Keir and Cawder Limited.

conveyor belts for bricks. This is a most delicate operation since the soft, green brick must not be damaged in any way before they are fully cured; one of their most recent installations is at Leeds.

Another product is a portable belt loader, which can be used for a variety of purposes; one model is fitted with a luffing head. There is a wide range of models, with lengths varying from 25 to 60 feet. The belts may be troughed or flat and are made from rubber-covered canvas. A simple spring-loaded tensioning device ensures correct adjustment of the belt, thus prolonging its useful life. The luffing head is hydraulically operated by hand-driven pump or motor pump and the main power unit can be an electric motor, or Diesel or petrol engine.

Conveyor belts built by Keir and Cawder include the one used to supply aggregate for the Loch Sloy Dam; the belt extended for about a mile and a half. Another of their systems has been installed at what is believed to be the world's largest quarry at Quenast in Belgium where a comprehensive scheme proposed by Keir and Cawder speeded up the entire process of handling the products.

MOBILE CRUSHING PLANT

Among the Division's most interesting products is the " Kompac " range of mobile crushing and screening plant. This equipment is used for road development and production of concrete aggregate, and comprises three units, a primary crushing unit, a secondary crushing unit and a screening and bunker unit. All models can be made for excavator or lorry feed, and jacks support the complete plant when it is in action. In the first series of three models, the primary and secondary crushers are each driven by a 40 b.h.p. engine, and the secondary crusher consists of a gyrating cone.

The Mark I version incorporates a 24 in. by 12 in. primary jaw crusher and a range of settings from 1¼ in. to 3½ in., and has a capacity of between 20 and 50 tons per hour, depending on the setting and conditions. The dimensions of the primary jaw crusher for the Mark II model are 24 in. by 15 in. and the jaw settings range from 1¼ in. to 3½ in.; its capacity is between 25 and 50 tons per hour. The primary crushing unit (Fig. 17) of the Mark III model has a jaw crusher 30 in. by 15 in. and a range of jaw settings from 1¼ in. to 4 in.; it has a capacity of from 35 to 65 tons per hour.

The screening and bunker unit for all three models has a 120 in. by 36 in. triple-deck roller-bearing vibrator with positive vibration produced by an eccentric shaft. The meshes are made from woven wire or perforated plate and mesh tensioning may be easily adjusted. The storage bin is of 20 tons capacity and has four compartments. The unit is driven by a 30 b.h.p. engine, rated to suit climatic conditions. The travelling height of the complete set is 14 ft. and its width 9 ft. 1 in.; its height when operating is 25 ft. 8 in.

Apart from the three models already described, there are a number of other mobile plants in the Kompac range. One of these, the Mark VI/A, which is a combined crushing and screening unit, is illustrated in Fig. 18. Other single-unit plants but considerably smaller are the Marks VII and VIII. These are designed to meet the need for a mobile unit having a minimum of mechanical parts. Their features include a roller-bearing jaw crusher with an overload safety device and non-choking curved jaw plates, and a simple rotating cylindrical screen driven by a totally enclosed reduction gearbox and capable of producing five crushed sizes.

Both models can be fitted with either Diesel or petrol engines. Their capacities and dimensions are given in the accompanying table.

—	Mark VII	Mark VIII
Capacity of plant ..	up to 12 tons per hour	20 tons per hour
Jaw crusher	12 in. by 7 in.	16 in. by 9 in.
Range of jaw setting	¼ in. to 2½ in.	¼ in. to 2½ in.
Screen	2 ft. dia. by 6 ft. (in 3 sections)	2 ft. 6 in. dia. by 8 ft. (in 3 sections)
Overall length (with drawbar up) .	16 ft.	18 ft.
Overall width ..	6 ft. 9 in.	7 ft. 3 in.
Overall height ..	8 ft. 7 in.	9 ft.
Gross weight ..	5·5 tons	6·3 tons

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ALUMINIUM ALLOY FOR BUSBARS

Aluminium is being used to replace copper in many applications in the electrical industry, particularly where lightness is a criterion, as is the case in overhead transmission lines. The Northern Aluminium Company, Limited, Banbury, Oxfordshire, have now produced an aluminium alloy which is suitable for use as busbars. It will be known as Noral D50S.

In spite of the fact that the aluminium bars will have to be larger than their copper counterparts, owing to their lower conductivity, the increased mechanical strength of the new alloy will compensate for this. The figures given are: ultimate tensile strength, 13 tons per sq. in.; minimum 0·1 per cent. proof stress, 10·5 tons per sq. in.; and electrical resistivity 3·133 microhms per cm. at 20 deg. C. The conductivity is lower than that of the unalloyed aluminium but this is partly offset by the fact that its temperature coefficient of resistance, at 0·00364 per deg. C., is also lower. The alloy bars may be rated at 96 per cent. of the current values for geometrically similar bars of electrical purity aluminium. It is at present available in extruded sections but could be produced in the form of plate for making very large rectangular bars.

Fig. 17 Primary crushing unit of Keir and Cawder "Kompac" Mark III mobile crushing and screening plant. Like Marks I and II this equipment is in three sections: the primary crusher, a secondary crusher and a screening and bunker unit.

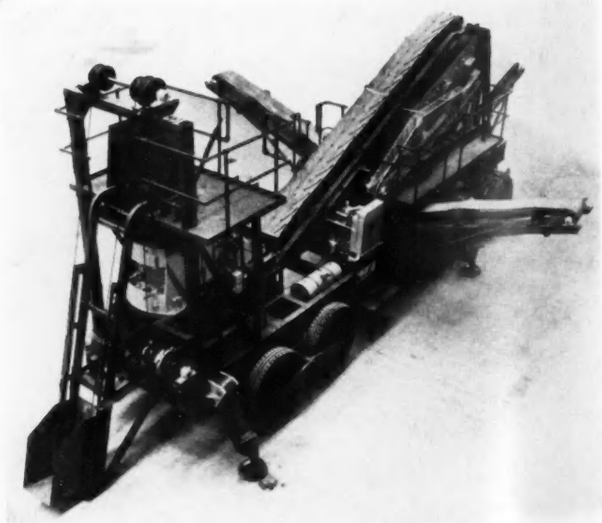

Fig. 18 "Kompac" Mark VI/A mobile single-unit combined crushing and screening plant. There also are two light-weight models in the series.

Institution of Naval Architects Spring Meeting (*continued from page* 460)

VISCOUS AND INTERFERENCE EFFECTS

The second paper presented at the afternoon session, on March 21, in the Spring Meeting of the Institution of Naval Architects was by Dr. G. Hughes, who described the "Viscous and Interference Effects Deduced from N.S.M.B. and N.P.L. 'Victory' Model Tests." The chairman at this session was Sir Stanley V. Goodall, K.C.B., O.B.E.

EXPERIMENTS ON VICTORY MODELS

The paper described some results obtained from a series of tests at the National Physical Laboratory with a model of a Victory ship, and the comparison of these results with those obtained in the Netherlands Ship Model Basin at Wageningen in testing a similar model. The combined results were analysed in relation to assumed viscous formulations, and the tank boundary interference effects required to provide a balance were then deduced. The N.P.L. models differed from those of the N.S.M.B. in that the slightly twisted "contra-stern" of the original design was not reproduced and the swelling representing the stern tube, propeller boss and cone was omitted. As a check, tests were made at one scale with and without the swelling, and it was found that there was no measurable difference in the resistance. The investigation showed that the interference effects corresponding to the viscous formulation proposed by the author in earlier work were consistent and reasonable, though further work was necessary to establish greater accuracy.

Dr. Hughes stated that the work was being continued. A considerable amount of other data had been collected and work was proceeding on other forms. He suggested that it would be unwise to draw too firm conclusions from the results in the paper. It might be found that the interference at low Froude numbers was linear with blockage; but there was evidence of a partial linearity if the Froude number was increased beyond the range of those particular tests. It might prove to be a bottom effect rather than a pure blockage effect.

Professor G. Aertssen thought that the conclusions of the Dutch scientists on their Victory model work were not pertinent enough to permit a generally admitted formula for three-dimensional extrapolation of skin friction to be established. It was a good scheme for Dr. Hughes to complete the programme by similar tests at the N.P.L. and to compare the results from both tanks in a re-analysis of the data. That the interference effect was linear and increased with speed in a normal way was certainly an argument on which to base a viscous formulation; but the weakness of the argument was that the intensity of that interference was not known in any other way. The interference values given in the paper were surprisingly high, and more evidence on that point was desirable.

Why had so little been said about the model boat at Wageningen? Its scale was so large that the results could not be ignored. The Dutch experimenters said that the boat was hydraulically smooth, but some of the illustrations showed a substantial roughness. The Tervaete would give a much higher roughness allowance; but that ship was eight years old and no more than commercially clean during the best of her trials. It would be appreciated if more were known of the state of the hull of the model boat, D. C. Endert, Jnr.

FULL-SCALE TESTS NEEDED

In time, a full-scale resistance test would be carried out on a Victory ship. That was the best method. Meanwhile, the measurement of local resistance in large ships was certainly useful for the establishment of the extrapolator. Movable plates in the hull did not give much information; why not take Pitot traverses to establish local frictional resistance and roughness?

Dr. J. D. van Manen expressed surprise that Dr. Hughes had not gone farther with the Dutch data from Victory models. He considered that too much value should not be attached to the results of interference values in Figs. 15 and 26 of the paper.

Mr. P. R. Crewe said that he was associated with a small towing tank of semi-circular cross-section. Another tank was being constructed, a little bigger than the first, but still rather small; it was 12 ft. wide and had a 5 ft. depth of water. To calibrate that tank, and in the hope of providing a little more information, two Victory ship models had been built, to 1/50th and 1/80th scale. They were finished very carefully with a black plastic, almost as reflecting as a mirror; the intention was to use chemical indicators to determine laminar flow. Investigations were proceeding on the effects of various types of turbulence stimulation, using studs and wires, and also by inducing vibration of the models. Taking Dr. Hughes's 1/32 scale data as the basis, the very tentative finding was that, in the speed range from 3 to 13 knots, the results obtained would agree with the Schoenherr formulation; in which range, for that very small model, Dr. Hughes's formulation lay above the Schoenherr formulation. He thought that a strong reason why the Schoenherr formulation had been favoured in the United States was that it did allow such small models to be scaled up. In aircraft wind tunnels, especially high-speed wind tunnels, there was the very serious problem of blockage, but there were mathematical formulae of sufficient accuracy for that purpose, and he felt confident that the same must be true in assessing small models in a ship tank.

Professor A. M. Robb said that, if what had been stated about blockage resistance were ture, it was very disconcerting since it showed that all tank results were unreliable. The theory of waves indicated serious interference effects with depth and, if that were true, the submarine going for shelter would be in a difficult position. The wave disturbance died out below the surface; so that any effect due to blockage would disappear very rapidly, and the line should not extend down to zero blockage. Dr. Hughes had used his own friction line as a standard; but had he a right to base anything on that as a standard ? On the question of stimulation, the position was far from clear. It had been stated that the trip wire had solved all the problems. Now the trip wire seemed to be thrown overboard and the use of studs was recommended. Was Dr. Hughes really justified in plotting viscous differentials from curves with scattered spots? Surely he should join up every spot. Finally, said Professor Robb, he wondered whether Dr. Hughes was trying out his line on the Institution in preparation for next year's International Conference of Tank Superintendents. The Skin Friction Committee was enjoined to produce an agreed line, but had refused to accept the Schoenherr line, which was founded on a very shaky basis. He would not like a British representative to say that Dr. Hughes's line rested on any sounder basis.

EFFECTS OF LAMINAR FLOW

Dr. J. F. Allan took exception to the suggestion that Dr. Hughes, or the N.P.L., was using the Institution as a guinea pig; they were both to be congratulated on putting their information forward at that stage, so that it was available for consideration. As Professor Robb had said, the International Skin Friction Committee was enjoined at the last Conference to study the matter urgently and to bring forward proposals to the next Conference; that was why the work had been pressed on. The series of experiments on the Victory ship models, and several other series, had been carried out on different forms, to provide as much accurate geosim data as possible for study in that connection. Very great care was taken to ensure the highest possible degree of accuracy. The serious divergencies between the results in the diagrams were attributed by the author to laminar flow areas and boundary effects; an argument, carefully developed, which seemed to be reasonably justified. But there was no absolute proof of the extent of the laminar areas; that might be considered a point of criticism against the data. The work was essentially directed to the study of extrapolation, but in the course of that study it was found that laminar flow and boundary effects were of importance if anything was to result from the data. To some extent they had become side-tracked from the main purpose, and the paper seemed to concentrate more on the boundary effect than on extrapolating.

In dealing with the section of the paper on the analysis of corrected results, Dr. Allan drew attention to the question of the extrapolator. He said Dr. Hughes had been taken to task, perhaps unjustly, for basing most of his analyses on his 1·27 form factor; actually, he had gone out of his way several times to explain the effects of using a different extrapolator. Though the boundary interference differentials changed to a material extent, depending on whether the 1·27 factor or some other value was used, they would not be invalidated by a variation of the form factor. In other words, the author's general conclusion regarding the effects of speed on boundary interference would stand, whether the 1·27 factor or another factor were adopted, within a considerable range. The important matter was not the absolute height of the extrapolator, but its slope.

Professor E. V. Telfer prefaced his remarks with some diagrams indicating the curious forms that tank interference could take, and went on to say that, in some of his own work, using the Hughes line within the limited data, he found himself in accord with Dr. Hughes. All that Dr. Hughes had said, in effect, was that he refused to accept Telfer's work; that he would take it to pieces himself and see, step by step, whether he could get the same results under the pseudonym of the Hughes line. He did not prove that the Hughes line was any more correct than the extrapolator. So far as his experimental work was concerned, Dr. Telfer had no fault to find, but the results were capable of greater accuracy, particularly for the smaller models.

Dr. Hughes, in reply to Professor Aertssen, said that he had avoided any too firm conclusions from the analyses; he had merely put forward an honest statement of what had been learned from the tests, and the results did not appear to line up with those of the N.S.M.B.

If he took the 1·27 line, he agreed with Professor Telfer; he had checked with the same slope as the 1·27 line, as given by his extrapolator, using the values of about 0·3 and 0·6, which was the model range. Using that slope apparently gave a linear blockage result. Dr. Telfer was prepared to say that it must be linear; Dr. Hughes was inclined to agree with him, but preferred to await more data. He was a little surprised by Dr. van Manen's very limited contribution, having hoped that there would be rather more of an attempt to bring their respective results together. The differences between them perhaps lay in the interpretation. In his own analyses, the Wageningen results did not contribute much to the determination of the blockage effect, because the blockage values for all the Wageningen model results were small, due to the larger size of the tank.

WORK ON SMALL MODELS

He was interested to hear that Mr. Crewe's organisation had already started work on some small models, but doubted whether they would get much from the model of 1/80th scale. He did not use the very smallest Wageningen model, because to deduce a really accurate result for complete turbulence for such small models was a very doubtful proposition. It was clear, with the stimulators used at the N.P.L. and those used at Wageningen, that even for the smaller models there was extreme doubt concerning the true answer; though he would not say that small models did not give valuable results in certain cases.

Most of Professor Robb's remarks called for a reply in writing. Dr. Robb had asked why he had used his own friction line, the Hughes line, as a standard. Professor Telfer's line could have been used, but he deliberately showed the effect of varying slope; so what did it matter which line was used ? Naturally, he took his own standard. He did not claim at that stage that it was necessarily correct, but he thought it was based on more consistent and reliable data than any other. Dr. Allan had, to some extent, answered some other contributors and there was no need to refer further to his remarks, except to agree with the empahsis he had put on the slope. While he agreed with Dr. Telfer that they reached the same answers, he did not think that that necessarily proved the Telfer extrapolator to be more right than the Hughes; but they were approaching some agreement about the slopes required. Dr. Telfer had said that the data did not extend beyond a certain point, but neither did his. What was claimed was that the slope of the formula proposed in the paper was consistent with the data, which did not extend as far as the Lucy Ashton ship basis. In the higher levels, in the regions where they were obliged to work, they got slopes which conformed with the slopes given when they used the extrapolator proposed. The formula gave the right answer at the higher levels, and that was all that mattered.

The report of the meeting will be continued.

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LOW-ALLOY STEELS FOR PRESSURE VESSELS: CONFERENCE

A one-day conference on the "Application of Low-Alloy Steels for Welded Pressure Vessels" will be held under the auspices of the West of Scotland Iron and Steel Institute at 39 Elmbank-crescent, Glasgow, C.2, on Friday, October 19.

Six papers by British and overseas authors will be presented during the morning session, from 10 a.m. to 12.45 p.m., and these will be discussed at the afternoon session, from 2.15 until 4.45 p.m. The registration fee, including one set of preprints will be £1 15*s*. (members of the Institute £1 5*s*.). A set of preprints only will be 15*s*., while the cost of the lunch will be 12*s*. 6*d*. Applications from intending participants should be sent to the secretary of the Institute, at the address given above, not later than October 8

The main airframe repair shop at the Royal Naval Aircraft Yard, Fleetlands, where Seahawk aircraft undergo major overhaul and modification. The Fleetlands organisation makes use of modern work study techniques and was the first naval aircraft yard to introduce an incentive scheme.

REPAIRS AND "MODS" TO NAVAL AIRCRAFT

WORK PLANNING AT R.N.A.Y. FLEETLANDS

The opportunity occurred recently to visit the best equipped of the Royal Navy's three aircraft repair bases—the Royal Naval Aircraft Yard at Fleetlands, near Gosport, Hampshire—and to learn something of its organisation and the way in which modern industrial engineering practices are being applied.

When Fleetlands was established in 1940, in the early stages of the second World War, the aim was to set up a flexible organisation which could change tasks at short notice to fulfil the Navy's urgent requirements. This object was achieved both at Fleetlands and at her sister repair yards at Belfast and Donibristle, Scotland. To-day, some of this flexibility has inevitably been lost as a result of the complexity of high-speed jet aircraft, the fixtures and tooling for which cannot be so readily improvised; but since the Royal Naval Aircraft Yards exist solely for repair and modifications work, and do not have to compete with production needs, as may be the case when aircraft are returned to their manufacturers for overhaul, these establishments still offer the most efficient and expeditious means for carrying out the Navy's aircraft repairs. Cutting costs and turn-round time, while restoring the aircraft to the " as new " condition and current modification standard, are the primary objectives of the Fleetlands organisation.

Fleetlands' present task comprises the repair and modification of Sea Hawks and their Rolls-Royce Nene engines and equipment, and also a certain amount of repair and modification work for the Director of Stores at the Admiralty, and jobbing work for the Home Air Command. Fleetlands is also preparing for the rectification of the de Havilland Ghost engines of the Navy's Sea Venoms and, later, when the D.H.110 aircraft enter service, Rolls-Royce Avon engines. Sea Venom repairs and modifications are carried out at the Belfast Yard, and those of the Fairey Gannets and their Armstrong Siddeley Double Mamba engines at Donibristle.

The Fleetlands Yard covers 73 acres and comprises a number of separate hangars and workshops. This arrangement was influenced by the need for dispersal during the war years when Fleetlands was established, and by the system of Annual Estimates by which the Admiralty is financed.

The main shops comprise strip and survey; paint strip; the main airframe repair shop where the major fuselage work is carried out; aerofoils and joinery workshop; heavy metal work; engine repair and machine shop; coppersmith/sheet metal work and metal detail, with a section for fuel tank repairs; the hydraulic shop; electrical radio/radar shop; an armament section, adjacent to the gun test butts; an aircraft refinishing shop; and an apprentice training hangar, which is shared with the yard machinery installation and maintenance section.

In addition, there are four stores, two fully silenced jet-engine test houses, engine running-up bases, an apprentices' school building, a research laboratory and a drawing office. The purpose of the latter is to prepare major repair schemes for all aircraft, and obtain design clearance for these schemes, to arrange liaison with the aircraft firms on technical matters, design test rigs to suit local requirements, compile works and machinery projects, and to provide an information service of drawings and technical publications.

As in H.M. Dockyards, civilian labour is employed in the R.N. Aircraft Yards under the supervision of naval officers, a system which has proved most satisfactory in practice, with unusual freedom from labour disputes. At Fleetlands this happy relationship between labour and supervision is fostered by a flourishing social life and sports activities.

The Superintendent holds the rank of Captain. Directly responsible to him are four Commanders: the Works Manager, who is the Deputy Superintendent, the Planning Manager, the Electrical Officer and the Chief Inspection Officer; the remaining Heads of Departments are civilians, as are most of the other officers of the Yard.

The Works Manager is responsible for co-ordinating and carrying out the work in the shops. Although the Electrical Officer is directly responsible to the Superintendent for all electrical repairs, he works in close liaison with the Works Manager and times his shop operations to suit the schedule laid down by the Works Manager. The Chief Inspection Officer's responsibility is to set the standards to which the work is to be carried out and to ensure that those standards are maintained in practice. The Planning Manager is responsible for the forward plans, rate fixing matters, and day-to-day job and shop planning, the application of work study, shop layout, programme planning, progressing and job control.

The total workforce at Fleetlands is about 1,400, of which 170 are " non-industrial "—of technician or executive status—employed in administration, planning, inspection, production, stores or drawing office. Of the 1,200 " industrials " about 670 are skilled craftsmen. Most of the labour is drawn from the local population or from ex-service personnel; but the apprentice training school, which numbers about 130, is now attracting young men from farther afield.

INCENTIVE BONUS SCHEME

Fleetlands was the first of the Naval work yards to introduce an incentive scheme, and the satisfactory results obtained have now led to a general policy of incentives throughout naval aircraft yards. When first introduced at Fleetlands ten years ago, the Halsey scheme was operated. In 1952, a changeover was made to a straight-forward percentage bonus scheme. As an example of how the scheme has increased the annual throughput of aircraft, and at the same time has resulted in economies in manpower, during the year 1945-1946, before the full effects of the scheme had become apparent, 60 aircraft and 150 engines were reconditioned. In 1952-1953, with 200 less operatives in the Yard, 135 aircraft and 265 engines were reconditioned.

Since then the figures have dropped because the Yard has been changing tasks from Fireflies, Sea Furies and Seafires to jet-powered Sea Hawks; thus it has been necessary to revise the layout of the factory and to re-equip it extensively to handle the modern machine. The Sea Hawk flying hours are now increasing rapidly, and it will not be long before there is a

regular flow of these aircraft requiring reconditioning.

The quality of the work is safeguarded by the fact that the inspection staff have to certify on the men's bonus cards that the job has been completed to their satisfaction before payment can be made. The inspection staff do not themselves participate in the bonus scheme.

The rate fixing and planning staff of all the Aircraft Yards, who work out the standard times and prepare the sequencing of operations, receive training in method study at Fleetlands, which is the Navy's pioneer establishment in this practice. Senior officers attend work study courses at the Birmingham University, and the subordinate officers at the Birmingham School of Technology, in order to keep abreast of advances in modern method study techniques.

STANDARD BREAKDOWN

The work of the Forward Planning Section commences about two years before the first of a new aircraft type arrives, with the problems of the layout of the shops, the acquisition of the necessary plant, equipment and tooling, and on deciding the best methods of achieving a standard breakdown for the aircraft; finally, there is the necessary documentation, in order to achieve a standard procedure. This is based upon a complete strip of an advanced machine by the planning staff, assisted by technical progress men, the latter being aircraft fitters with a higher rate of pay for their special duties in assisting the planning staff to achieve a properly sequenced run-out of operations.

The standard breakdown procedure makes possible the maximum utilisation of inspectors and operatives and since the main components—centre fuselage, front fuselage, rear fuselage, port and starboard wings, in the case of the Sea Hawk—are surveyed in parallel, stores requirements are ascertained at the earliest possible moment. Generally some 80 per cent. of all stores items are held at Fleetlands, and most of the remainder can be obtained within three weeks.

A basic floor plan is drawn up which shows the space, time and manpower requirements for each phase of work on each major component, and shows when the various jobs require to be co-ordinated—e.g., at what stage the fuel tanks are required for re-installation in the re-built front fuselage, etc. A sliding date scale incorporated in the floor plan enables the target dates to be calculated; these are co-ordinated with the detailed job cards issued for standardising breakdown, repair and rebuild operations on the floor.

PICTORIAL SCHEDULES

Coloured pictorial schedules, keyed with an action list, are prepared, as an aid to the examiner carrying out the survey, in locating and identifying damaged or missing items requiring replacement; all related systems, such as airbrake surfaces and their control levers, attachment pins, etc., are identically coloured.

The pictorial representation is carried through to the repair shops. The survey examiner enters up the damage on a line-diagram "action list," and calls up the necessary rectification work on a survey action list. These lists are sent as an "aircraft pack" to a central office where Block and Anderson duplicating machines produce the action and documentation such as operative's bonus card, single line demand vouchers for spares and modifications call up, and progress record cards for the Progress Section. This duplicating system has eliminated much manual writing and typewriting which was associated with the previous system.

Progress chasers maintain a visual display of the progress of each component through the shops, and a man-loading chart, colour-coded by trade, shows up hold-ups on any particular aircraft, enabling components to be re-allocated where necessary to smooth out the flow of work. An interesting feature of the Fleetlands organisation is the Weekly Progress Meeting, at which such hold-ups are analysed in detail. An incidental advantage of the incentive bonus scheme is that the men's bonus cards provide an accurate record of waiting time and, at these weekly meetings, management is made aware of all the causes of delay throughout the Yard, and takes steps to overcome them. The elimination of waiting time, which is paid at the standard rate only, means more production and higher earnings.

Turning now to a brief consideration of the actual progress of the aircraft through the Yard: the aircraft may come in for what is known as a "Category 4 recondition" after completing a standard service life, determined by the Admiralty, and based on an assessment of time in months during which the aircraft can be regarded as in the fully-operational condition; or they may come in at the end of a Carrier cycle of operations for a Category 2 minor rectification and modification programme, in accordance with the current Admiralty policy, before re-issue to Naval Air Squadrons; damaged aircraft also come in at irregular intervals for major repairs. It is to cater for these varying tasks that the flexible planning of the work is essential.

The aircraft arrive either by road, after landing at a nearby airfield which is connected with Fleetlands by a road specially built for the purpose, or by lighter from the aircraft carriers; a new jetty is currently under construction for the reception of aircraft lighters. Before the aircraft is programmed for feed-in for overhaul, a preliminary survey is carried out by a team consisting of representatives of production, inspection and planning at supervisors' level, in order to determine which category of work is called for, after which the aircraft is sent to the paint strip shop. From the paint strip shop it passes to the strip and survey hangar, where it is broken down to major components and surveyed in detail. The aerofoil surfaces and minor components are removed and sent to their various component shops where the detailed survey on these items is carried out, followed by repair or reconditioning. The major components are passed to the main airframe repair shop for Category 4 repairs. Ultimately the repaired components are sequenced back to the major assemblies which are brought together for reconstruction according to programme in the main shop. Category 2 work is not carried out in the main shop, but in subsidiary hangars where the inspection rectification and embodiment of "mods" is conducted under one roof.

NAVAL AIRCRAFT MATERIALS LABORATORY

In conclusion, we should like to refer again to the Naval Aircraft Materials Laboratory which, although located geographically at Fleetlands, exists for the use of the whole of the Fleet Air Arm. Its general function is to carry out investigations of a chemical, metallurgical and general scientific nature arising in Naval aviation. The laboratory renders assistance to the Admiralty Aircraft Accident Investigation Unit, and is also in close touch with the other repair yards, aircraft workshops and air stations on day to day problems.

The accent is on applied research and much of the value of the laboratory comes from its very close contact with the Service users of naval aircraft. The range of work covered is considerable, embracing ferrous and non-ferrous metallurgy, corrosion prevention by metallic or organic coatings, fuels, lubricants, strippable plastics preservation of aircraft, and a wide variety of other subjects associated with the behaviour of materials in naval aircraft. Numerous examples of the laboratory's activities can be listed: one involved internal treatment of fuel tanks which had corroded under certain conditions of carrier operation, another concerned the failure in service of certain high strength aluminium alloy forgings with high internal stress levels and suspected internal defects—this latter aspect was being reviewed by ultrasonic inspection.

The staff complement of the laboratory is comparatively small; but effective, and continually increasing, use is being made of this department's facilities.

WRAPPING MACHINE SAFETY GUARD

A particular adaptation of the machine guard utilising photo-electric cells, has recently been constructed by Radiovisor Parent Limited, 1, Stanhope-street, London, N.W.1, for use on a bandage wrapping machine, a general view of which is given in the illustration.

The machine is completely automatic and providing operator protection is complicated by the allowance that has to be made for the nature of the wrapped material, the "Elastoplast" bandage. Special wrapping paper has to be used to preserve the quality, and the machine cuts the paper to size, wraps it round the bandage, folds and seals with gum, producing a completely wrapped product. It is particularly necessary that the operator shall have a clear, uninhibited view of the machine with ready accessibility for maintenance, and at the same time that there should be immediate stoppage in an emergency. Immediately the light curtain is broken, even when by an instinctive movement of the operator to correct a fault in the wrapping, the machine is brought to rest. The projector consists of a number of low-voltage lamps arranged vertically to give a curtain 16 in. high surrounding the top of the machine except for the one side which is inaccessible. The light from the projector is reflected by two sets of mirrors on to the receiver, so that a continuous curtain is formed from a single light source. Any attempt by the operator to reach the mechanism (as shown in the illustration) must interrupt the beam thereby bringing the machine to a stop.

Accidents to operators working this machine for wrapping adhesive bandages are prevented by a curtain of light which extends round the three open sides, being reflected from a single source (on the left) by mirrors.

Book Reviews

CUTTING CIVIL ENGINEERING COSTS

Construction Planning, Equipment, and Methods. By R. L. PEURIFOY. *McGraw-Hill Book Company, Incorporated, 330 West 42nd-street, New York 36, N.Y., U.S.A.* (8.50 dols.); and *McGraw-Hill Publishing Company, Limited, 95 Farringdon-street, London, E.C.4.* (64*s*.)

This, surely, must be one of the most comprehensive books ever devoted to the problems of civil engineering construction. Over 500 pages of carefully prepared information are offered in a style which is easy to read and yet not more technical than the particular subject requires.

October 1953

May 1954

May 1955

May 1956

Successive stages in the construction of an office block at Holborn Viaduct, London. Precise programming of the labour force, materials and plant is essential to economic construction, as is discussed in the review on this page. John Mowlem and Company Limited were the principal contractors for the work illustrated.

An introductory chapter stresses the important point that any construction project is an essay in economics. Art for art's sake is rare in civil engineering, and the best design for any particular project is that which satisfies the functional requirements of the project at the least cost, allowing, however, that the quality of the finish of the work is an aspect of the function. Those parts of a structure which are to be seen must be attractive to look at as well as functionally adequate. This chapter includes a list of 12 headings under which the design engineer may contribute to lower costs of construction, and while some of these may appear to overlap, they nevertheless constitute sound advice which is, unhappily, often ignored.

Reduced to its simplest terms the planning of constructional work amounts to: What—How—When. The planning engineer must have a clear conception of what it is that he is going to build. This means, in effect, that he must have full working drawings giving all important details of the scheme; he must have a specification showing the standards to which the work is to be carried out, and the quality of such variable items as concrete mixes; and he must also have, or must prepare from the drawings, a bill of quantities which will enable him to assess the quantity of work which he is to carry out under various headings. The author does not dwell unnecessarily on these essential pre-requisites to a properly planned construction; he might very likely believe that the matter is so obvious as not to need mention, and perhaps in America the practice is to carry out a full site investigation and to prepare all contract documents before construction starts. In Great Britain, and particularly since the war, this desirable practice has not always been observed. Many projects have been started on the barest outline drawings, and with little or no proper site investigation. The result too often is delays and alterations right from the start: as soon as the ground is opened it is discovered that the foundations need to be modified, and the construction schedule undergoes its first revision.

On the matter of "How and When," the author gives full measure. Chapter 3 is entirely devoted to "Factors affecting the Selection of Construction Equipment," and in it the author points out, with the aid of practical examples, the need for the contractor to consider all possible methods for carrying out each part of the project. He illustrates the need to balance the ownership cost of plant against running expenses and output, and shows that one plant layout may be the most economical for a particular operation when the quantity is relatively small, while another layout may be correct for the same operation when larger quantities are involved.

In another chapter the author discusses job planning and management, and offers a number of *pro formas* suitable for recording essential data and controlling the job while it is in progress. From these analyses the project manager is able to forecast his requirements, both in quantity and time, of all the different categories of labour and all the different materials which he will require at different stages in the work. The basic chart is the "construction schedule," of which two examples for different types of job are given. This schedule is of the well-known type in which a certain period is allotted for the completion of any particular item, and actual progress is recorded on the same time scale with completion percentages given at any required date. This form of chart gives a general overall picture of the progress actually achieved against the programme as forecast. It may be advisable, however, to supplement the chart with a cumulative output curve for certain essential items. The chart does not show the trend of output whereas the curve does. For instance, in the case of a concrete dam, the rate of concreting will not be constant. Delays will occur at the start due to teething troubles at the plant, and while the men are being trained. The foundations may take longer to prepare than was expected due to bad ground. Then a period of more or less constant output at a rate higher than the overall average should follow, and towards the end of the contract, due to confined working room at the top of the dam and so on, concreting output will inevitably fall off. The construction schedule may show that with 30 per cent. of the time gone only 15 per cent. of the concrete has been placed, but so long as the curve shows a steadily rising output at that time, the situation is properly in hand. If the chart showed that with 80 per cent. of the time gone, 80 per cent. of the concrete had been placed, that would not be a satisfactory picture. In order to complete on time it may be necessary to have 90 or even 95 per cent. of the concrete placed when only 80 per cent. of the time allowed for concreting has elapsed.

Having discussed the foundations of his subject in these opening chapters, the author then proceeds to give an extremely comprehensive description of the methods and equipment available for carrying out the widely varying operations encountered in civil engineering construction. This section of the book is covered in chapters 5 to 19 inclusive, and each is devoted to a particular topic. Each chapter is again sub-divided for easy reference. These chapters deal not only with well-known subjects, such as concreting, pile driving and excavating, but also with less usual matters, such as belt-conveyor systems, foundation grouting or the production of crushed-stone aggregates. It is inevitable, when assailing so wide a field, that any particular subject may perhaps seem to be incompletely covered. In the chapter on "Concrete," for instance, the whole subject of underwater concreting is discussed in one short paragraph on page 498, and in the two chapters on "Drilling and Blasting Rock" and "Tunnelling," excellent though they are, no reference could be found to the air-leg mounting for jack hammers, which has largely displaced the drifter (referred to on page 279) for rock tunnelling in Scotland. However, the author is generous in the bibliography which he gives at the end of each chapter, and the reader is thus able to pursue any particular subject by reference to other authorities.

Outputs for plant, where given, are evidently for ideal conditions, and appear rather high judged by results familiar in the United Kingdom. Few contractors, for instance, would tender on 150 cub. yd. per hour measured in the cut and loaded into trucks for a 1½ cub. yd. excavator (page 13).

The book concludes with two appendices dealing with the cost of owning, maintaining and

operating a very extensive range of plant. This is the sort of data which takes years to accumulate and then can never be precise. Changes in taxation or in money values can upset depreciation calculations and some owners may prefer to spend more on overhauls while others allow a higher rate of depreciation. This difficulty is illustrated by the fact that in some cases the depreciation allowance for similar items of plant varies between one appendix and the other, but it does not prevent the data given here from being valuable as a means of comparing one type of plant with another, even if the absolute money values quoted may soon be out of date.

It is not possible in a brief review to cover all the aspects of this book. It is possible to say, however, that the book is an authoritative work and should not only be of value to the young engineer, but should also prove a most useful book of reference to the experienced construction superintendent.

HEIRS PRESUMPTIVE

Management Succession: The Recruitment, Selection, Training and Promotion of Managers. *The Acton Society Trust*, 39 *Welbeck-street, London, W.*1. (10*s.* 6*d.*)

The problem of who is going to step into the old man's shoes is, according to the anthropologists, older than history. In the tribe the problem was settled by a physical conflict, the image of which forms the Oedipus complex of the psycho-analysts. It may well be that it is the atavistic fears experienced by ageing directors which have debarred them in the past from selecting and training their successors, although the necessity for doing so has obviously grown with the development of large-scale industry at the expense of the family business.

Even to-day, according to this excellent report, only one third of the sample of 51 firms, employing over 7,000 people each, had made any systematic approach to the problem of recruiting, selecting, training and promoting managers, while another third do some of these things. Only a fifth of the companies studied have any serious programme of talent spotting and these use a variety of methods, including personnel records, merit rating and annual assessments, periodical interviews, internal advertising of vacancies (a very controversial subject) and informal observation by senior management at training courses and social activities. While two-thirds had some form of organised training, the greater part of it was found in the highly technical companies; the need for a broader training for technical men was not generally appreciated.

On the question of the management trainee there appears to be a general recognition that, while early selection and training is necessary if managers are to have the necessary variety of experience, the system employed must be flexible in its method and opportunities must be kept open for the training of those recruited internally from suitable early school leavers as well as of graduates.

As was to be expected, the proportion of graduates among managers is rapidly growing, as demonstrated by the fact that one in four managers between the ages of 35 and 39 had degrees, compared with one in 14 aged 60 and over. This proportion is rising much faster than in the population as a whole. Although all but 34 per cent. started at or near the bottom, the situation is changing and there is a distinct rise in the number with a grammar and, still more, public school education compared with those from other forms of secondary school. Those who attended one of the major public schools and those with arts degrees and non-technical qualifications, especially from Oxford and Cambridge, seem to have disproportionate advantages, although the figures here are not very conclusive. As much as 82 per cent. of present managers had no professional qualification whatever, but the proportion who have is rising among the younger men.

The authors draw attention to the enormous gap between the practices of those who recognise the problem and those who are oblivious of it and suggest that there is need of a more widespread realisation of the importance of management succession. The first necessity is an attitude of mind on the part of management which needs to be supplemented in large companies by a systematic programme, including both the forecasting of future requirements and estimation of potential supply and the selection and training of potential managers.

The report includes an interesting discussion on the extent to which employees are interested in promotion and how it is possible to make promotion schemes both be, and appear to be, fair. The inquiry disclosed a conflict between the interest in promotion expressed by a large majority of those interviewed, and their practical interest as evidenced by applications for vacancies or attendance at night school when this was recognised as conferring an advantage. In some cases the lack of financial incentive was an explanation.

There appeared to be little objection on the shop floor to the technical graduate; but non-technical graduates were resented, presumably because the leadership qualities often emphasised by management are suspect. It was also the view on the shop floor that the manager should have had experience of handling men at the foreman level, which few graduates, in fact, can ever have had.

The widening of educational opportunity, combined with the increasingly scientific nature of industrial operations, is going to force more and more firms to pay attention to their supply of future managers and to ensure that they are highly trained. It is inevitable that these people should form an elite group largely recruited from the universities or from grammar and public schools for special education by sandwich courses. Even if our educational system were fully democratic, which it is not yet, there would be serious social dangers in such a system if it became too rigid, and industry will have to steer a course between the generally prevailing anarchy in management recruitment and the creation of a closed caste.

TAKING FULL ADVANTAGE OF THE LOAD CAPACITY OF MATERIALS

Introduction to Plasticity. By ARIS PHILLIPS. *The Ronald Press Company*, 15 *East 26th-street, New York* 10, *N.Y., U.S.A.* (7 dols.)

The subject of plasticity is of growing interest to engineers in the field of the economical design of structures, the cold forming of metals and many other diverse engineering problems in which a considerable saving in weight can be achieved by previous overstraining of the material used. Under combined stresses, however, there is still a considerable lack of the reliable experimental information required to enable the fundamental principles to be firmly established. Nevertheless, it has been possible in some of the simpler problems to take advantage of our knowledge of metals at stresses beyond the yield. Much of the existing theoretical work is based on idealised stress-strain curves, but despite this it can frequently be applied to actual materials used in practice, and gives a clear indication of the advantage of designing for stresses beyond the yield.

In the design of structures it has been the practice in the past to ensure that the structure is completely elastic, and it is usual to think that such a design can be very accurate. The draw-back, however, is that calculations based on elastic behaviour are too sensitive to the unavoidable imperfections of the actual structure. This disadvantage is avoided if the design is based on the "collapse load" or the load at which large permanent strains will occur with no additional load being applied. This load is normally appreciably higher than the load to give elastic failure. Added advantages are the simplicity of the calculations required, and the considerable saving in weight which can be obtained with no real reduction in the factor of safety. There are of course many fundamental differences in the two methods of design, one of the most important being that the principle of superposition, so familiar in elastic theory, is no longer applicable.

Under more complicated states of stress the collapse load has only been determined for a relatively few cases. In some other problems only the upper and lower bounds to the solution have been obtained, the difference between these values being a measure of the error involved. The estimate of the strains involved at the collapse requires the introduction of stress-strain relationships which are still the subject of much research and some degree of uncertainty—an uncertainty which is not resolved as the instruments used become more refined.

One of the major difficulties which the practising engineer meets when considering designs involving stresses and strains beyond the yield is that the majority of the books available are highly mathematical, as the subject has been developed principally by applied mathematicians. Not only are the books highly mathematical but most (if not all) fail to state clearly and simply the fundamental principles or assumptions. There has been a real need for an elementary book on plasticity, and in many respects the book under review fills this need. Aris Phillips, who has contributed much to the knowledge on plasticity, has clearly stated the fundamental concepts involved, and has found it unnecessary to resort to advanced mathematics.

The first six chapters are devoted to one-dimensional problems and cover the plastic design of beams and frames subjected to bending and axial forces. Deflections of statically determinate and indeterminate beams are also considered. These chapters should be of interest to structural engineers. The last three chapters consider problems of combined stresses. In chapter 7, stress-strain relationships are considered and in chapters 8 and 9 the collapse loads under combined stresses and the effects of strain hardening are discussed for a few particular cases.

The introduction of the "octahedral shear stress" in chapter 7 might well be considered by some to be unnecessary, even if not confusing. The octahedral shear stress is a possible physical interpretation of the Mises-Hencky function of stresses; yet another interpretation is that it is equivalent to the maximum shear strain energy. The first interpretation seems to be not only useless but even misleading as the octahedral shear stress at yield is $\sqrt{2/3}$ of the yield shear stress in torsion, so giving the erroneous suggestion that the octahedral plane is weaker in shear. The concept is surely entirely unnecessary and one which might be usefully forgotten. It is also to be regretted that the author found it impossible to include a chapter on the effect of previous overstraining, as is practised for instance in the autofrettage of high-pressure vessels. Such a chapter could contain much of interest to the mechanical engineer.

The one or two criticisms which have been made of this book do not, however, detract seriously from its value and it can be recommended as an introduction to the subject. Teachers of strength of materials might be well advised to read it as it is time that the subject matter it contains, inevitably of great significance to engineers in the future, should be introduced at first degree level.

NEW BOOKS

Some of the books noticed here are selected for extended review in ENGINEERING.

The Cement Industry in Europe. *Organisation for European Economic Co-operation, 2 Rue André-Pascal, Paris 16e.* (350 francs); and *H.M. Stationery Office, Kingsway, London, W.C.2.* (7*s.*)

The danger that the production of cement may in the future outrun demand has led the Cement Working Party of the Organisation for European Economic Co-operation to emphasise the importance of finding new uses for that commodity. This need for new use was one of the main conclusions of the Party in its report to O.E.E.C. ("Trends in Economic Sectors"). The booklet, in which the position is analysed, is illustrated by graphs and maps, and deals with the following aspects: supply factors and trends, demand factors and trends, and price trends. There is a section in which the Working Party's conclusions are outlined and a large number of tables provide associated statistical data.

Design of Axially Loaded Reinforced Concrete Columns. By ANTHONY D'O. SMITH. *The Association of Engineering and Shipbuilding Draughtsmen, Onslow Hall, Little Green, Richmond, Surrey.* (2*s.*)

Current design and practice for reinforced concrete columns is based on C.P. 114 (1948), and this booklet is an analysis of the requirements of that code. It has been compiled specifically for the designer working on the drawing board and contains a number of useful tables that permit the rapid assessment of the strength of R.C. columns. It is to be noted that the 1948 edition of the code is at present in the course of revision and the new draft (which differs in considerable detail from the former) has already been circulated to interested bodies.

The Gas Turbine Manual. By R. J. WELSH and GEOFFREY WALLER. Second edition. *Temple Press, Limited, Bowling Green-lane, London, E.C.1.* (30*s.*)

Gas-turbine installations for power stations, ships, locomotives, cars and industrial purposes are described and illustrated in this manual, which contains particulars of 100 designs from ten different countries. Specifications of modern British gas turbines are given in ascending order of power output from 30 b.h.p. to 25,000 b.h.p., and appendices provide design data of British and foreign plants, a world list of manufacturers, various useful tables, and a glossary. Sections are included on gas-turbine history, materials, thermodynamics, cycles, fuel-ash problems and heat exchangers. The book, which is well illustrated, contains a bibliography and subject and name indexes.

The Foreman's Handbook. Edited by CARL HEYEL. Third edition. *McGraw-Hill Book Company, Incorporated, 330 West 42nd-street, New York 36, N.Y., U.S.A.* (6.50 dols.); and *McGraw-Hill Publishing Company, Limited, 95 Farringdon-street, London, E.C.4.* (49*s.*)

This edition is the second revised version of the original book, which appeared in 1943. Although much of the material contained in that work has been retained, all chapters have been critically re-examined and substantial alterations and improvements on the first revision, which was published in 1949, have been made. Statistical information and topical references have been brought up to date. The chapter on job evaluation has been re-cast to provide an explanation of those methods of ascertaining correct wage rates for specified jobs which are likely to be encountered by American foremen. The other 20 chapters of the book deal with such matters as leadership, quality control, time study, work simplification, industrial psychology, costing and safety. They have been written by 24 contributors and are divided into seven sections. An addition to this edition is the last section, comprising a series of self-questions to each chapter and accompanied by references to the relevant text. Specialised terms have been eliminated as far as possible and when used have been defined.

Modern Physics: A Textbook for Engineers. By ROBERT L. SPROULL. *John Wiley and Sons, Incorporated, 440 Fourth-avenue, New York 16, N.Y., U.S.A.* (7.75 dols.); and *Chapman and Hall, Limited, 37 Essex-street, London, W.C.2.* (62*s.*)

As the preface states, "The aim of this book is to present to engineers those parts of twentieth-century physics which are of greatest importance in engineering." The book has been developed from notes used on a course in atomic, solid-state and nuclear physics for engineering undergraduates at Cornell University. Two of the most important developments in recent years are the transistor and the nuclear power reactor, both of which are dealt with in a graduated series of chapters starting with fundamental particles, and ending with applied nuclear physics. Appendices on physical constants, periodic table and atomic weights, the conversion of m.k.s. to c.g.s. units, pulse spectra and the indeterminacy principle, and energy, momentum, and wave functions, and a table of atomic masses are also included.

Flow Production and Automation: Eighteen Axioms. By FRANK G. WOOLLARD. *Industrial Administration Group, c/o College of Technology, Gosta Green, Birmingham, 4.* (5*s.*)

This booklet emphasises that automation is the next step forward from flow production methods of organising production work, and summarises eighteen axioms for successful working which apply equally to both systems. The author, Mr. Frank G. Woollard, pioneered attempts at automation as long ago as 1923, and is recognised as one of the British authorities on flow production and automation methods.

Strength and Elasticity of Materials. Vol. IV: Part Two (External) B.Sc. (Engineering), 1941-52. By W. H. BROOKS. *Macdonald and Company (Publishers), Limited, 16 Maddox-street, London, W.1.* (35*s.*)

This book contains complete and, in many cases alternative, solutions to all questions set from 1941 to 1952, in the B.Sc.(Eng.) Part II general external examination papers I and II, on "Strength and Elasticity of Materials," of the University of London. As has been the case with Vols. I, II, and III, the solutions are grouped in sections, each dealing with a particular type of problem for the benefit of readers who may wish to concentrate on one type of problem at a time. The book is also addressed to candidates preparing themselves to take "Properties and Strength of Materials" in Section B of the I.Mech.E. associate-membership examination.

Working Metals by Electro-Sparking. By A. V. Nosov and D. V. BYKOV. An abridged translation from the Russian. Published for the Department of Scientific and Industrial Research by *H.M. Stationery Office, Kingsway, London, W.C.2.* (5*s.*)

This 66 page brochure has been prepared as a practical manual for engineers, technicians, foremen, and others concerned with the operation of electro-sparking units. Electro-spark machining is one of the newer techniques for working metals, particularly those of great hardness. In this technique, the erosive effect of repeated electrical discharges between a tool and the workpiece is used to carry out the work required. The tool itself does no actual abrading but acts only as an electrode. It can be made easily and cheaply from brass and no special treatment is required. The method can also be used for sharpening carbide tools with ease and safety without destroying their temper.

Aluminium in Contact with other Materials. Information Bulletin No. 21. *The Aluminium Development Association, 33 Grosvenor-street, London, W.1.* (2*s.*)

When aluminium is used in contact with a second material and under certain conditions, some simple precautions are required, and recommended practice is described in this *Bulletin*. Brief notes on the causes and types of corrosive attack are followed by the principles of preventing attack and then, at greater length, by accounts of the behaviour of aluminium in contact with specific materials. Practical means of preventing corrosion such as the use of inhibitors and jointing compounds, the method of cathodic protection, and the adoption of cladding and metal shaping are discussed.

Tragwerke aus Aluminium. By FRITZ STÜSSI. *Springer-Verlag, Reichpietschufer 20, Berlin, W.35, Germany.* (22.50 D.M.)

This book deals with aluminium for structural purposes. After describing the particular properties of aluminium, the essential principles are worked out for designing, calculating and executing structural work in aluminium alloys. Some theoretical questions are given brief attention, to help to ensure that this light metal is given the high-grade processing which it demands at all stages. The question of fatigue limit is dealt with relatively fully, and the text is supported by calculation formulae so that the work will be of interest to designers and constructors using this metal. Photographs and brief descriptions are given of a number of aluminium structures, to illustrate the use to which this lightweight metal has been put in various countries.

Knicken: Theorie und Berechnung von Knickstäben Knickvorschriften. By CURT F. KOLLBRUNNER and MARTIN MEISTER. *Springer-Verlag, Reichpietschufer 20, Berlin, W.35, Germany.* (27 D.M.)

In spite of the widespread literature on the buckling of metal structures, the authors direct this book to the practical engineer, as a guide to the significance of new conceptions and the principles underlying standard specifications. The Enges[illegible]ianello reiteration method is used for the nu[illegible]al solution of complicated cases and, while no [illegible] theories are developed, the present state of kno[illegible]dge on the subject of buckling strength is explained sufficiently for official definitions to be understood and for complicated cases to be solved numerically. After dealing with various cases of buckling, attention is paid to problems of stability and stresses. The fundamental principles of buckling specifications issued by several countries are compared with each other. The text is fully supported by formulae and diagrams.

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TRADE PUBLICATIONS

Copies of any of the following trade publications are obtainable from the addresses given though distribution is sometimes restricted.

Electrical Equipment for Education. CROMPTON PARKINSON, LTD., Crompton House, Aldwych, London, W.C.2. The use of C.P. electrical equipment and instruments in universities, technical colleges and schools; adaptations of apparatus for test and experimental purposes; services to educational establishments by C.P. contract department. Illustrated brochure.

Danger in the Office. RoSPA Industrial Safety Division, 38 Millbank, London, S.W.1. "Danger—Office Staff at Work," booklet illustrating dangers that exist and accidents that may occur in the office. Set out in the form of a picture quiz. Copies 6*d.* each or 37*s.* 6*d.* per 100.

Standard Dimension Motors. BRITISH THOMSON-HOUSTON CO. LTD., Rugby. Squirrel-cage three-phase 50 cycle induction motors ranging from 1 to 20 h.p. at four-pole speeds, with corresponding ratings at other speeds. Totally enclosed, fan-cooled with foot or flanged-end shield mounting. Standard fixing dimensions. Illustrated descriptive leaflet (DL 2144-3).

Industrial Selenium Rectifiers. GENERAL ELECTRIC CO. LTD., Kingsway, London, W.C.2. Technical details of industrial selenium rectifiers—basic circuits, mobile and light weight units, battery chargers, and similar equipment, for etching, railway signalling, marine use, cathodic protection, alternating-direct current conversion and experimental purposes. Fully illustrated descriptive pamphlet (V 3098).

Power Presses. WILKINS AND MITCHELL LTD., The Green, Darlaston, South Staffordshire. "TR" series of panel presses, capacities from 250 tons upwards. Press operation is by eccentric, with double-helical drive gear, pneumatic clutch and V-belt drive from motor. Slide is balanced by air cylinders. Pneumatic cushions can be fitted, with or without cushion arrestors and locks. Illustrated pamphlet.

Drop Hammers for Light Work. B. & S. MASSEY LTD., Openshaw, Manchester, 11. Drop hammers of two types, hand-pulled and automatic. Both are power-lifted, but control in the one case is by hand-pulled cord and in the other by foot-pedal. The automatic type can be set for continuous stroking. Both types are made up to 4 cwt. tup weight. The automatic type is built down to ¼ cwt. and the hand-pulled hammer down to 1 cwt. Illustrated pamphlet.

Valves and Television Tubes. FERRANTI LTD., Chadderton, Oldham, Lancs. Technical handbook containing full information on the firm's valves and cathode-ray tubes, including those specifically designed for industrial purposes. Available on a subscription basis. Abridged data covering same range published in a separate booklet. A third publication provides an introduction to the valves and cathode-ray tubes for use in industrial electronics and research.

Electronic and Batch Counters. LONDEX LTD., Anerley Works, 207 Anerley-road, London, S.E.20. Details of a new range of electronic and batch counters, including a pattern with photo-electric equipment and extension photo-cell and projectors. Illustrated leaflet.

Turbine Lubrication. WAKEFIELD-DICK INDUSTRIAL OILS LTD., P.D. Department, 46 Grosvenor-street, London, W.1. The lubrication of steam, gas and water turbines, and such points as selection of oil; care of oil; and operating problems. 80 page illustrated booklet.

Surface Finishing. A. A. JONES AND SHIPMAN LTD., Narborough-road South, Leicester. Leaflet describing a 16 mm. film on the generation of precision functional surfaces, issued by the Micromatic Hone Corp. Detroit, Michigan, which illustrates methods of obtaining special surface finishes.

PLASTICS PIPES AND CONTAINERS

COMPLETELY AUTOMATIC PRODUCTION FROM EXTRUSIONS

In 1954, partly as a result of the increase in the demand for extruded plastics and partly to improve deliveries to the Home Counties, the Extrusion Department of Thomas De La Rue and Company, Limited, was moved from Tynemouth to the Cavendish Works, Buckhold-road, Wandsworth, London, S.W.18. More recently, work has been concentrated on three main types: clear cellulose acetate containers; polythene, PVC and other thermoplastics tubes and pipes, ranging from capillary to 9 in. in diameter; and heavy rod stock (chiefly cellulose acetate butyrate) which is used mainly for tool handles.

Each of these processes follows the same general lines, namely: drying the raw material (not necessary in the case of some); softening under heat and pressure in the extrusion machine; cooling and solidifying of the extruded form, and cutting to length. In the case of containers there must be added the sealing of one end and the production of a cap for the other. Such containers are much in use nowadays for packaging goods for sale, such as toothbrushes, screws, etc. A container for screws, which is an inch in diameter and 2 in. long, is formed automatically from clear cellulose acetate, and being a typical example, its manufacture will be described in some detail.

CONTAINER MANUFACTURE

The acetate granules absorb moisture in store, and have to be dried before use. To do this, they are passed on a moving canvas belt below two sets of infra-red heating lamps, as shown in Fig. 1. The arrangement of two sets, one above the other, reduces the length of line needed to ensure that the granules are fully dried before entering the extrusion machine. In the arrangement shown, the granules travel first under the lower set of lamps from a feed hopper and are elevated to the second set by the conveyor in the foreground. The belt of the upper set delivers them to the hopper of the extrusion machine. Inside the machine the granules are heated till they soften and the material is then extruded through a die of the required shape (annular for tubes, for example) and solidified by water jets. The resulting tube is further cooled in water and is continuously drawn away between two superimposed belts.

MAINTAINING TUBE SHAPE

One of the problems in extruding tube, particularly when the walls are thin, is to maintain the true shape during solidification. This is usually done by maintaining air pressure within the tube during the extrusion. In order to avoid the necessity of plugging the open end of the tube to prevent the escape of air, and thereby limiting the length of tube which can be continuously extruded, the company use a patented process which allows the extrusion to continue uninterruptedly in spite of the fact that the tube is simultaneously being cut into lengths. This process entails the use of an iron "torpedo" which slides inside the tube and is held in place by an electromagnet surrounding the tube. One of these magnets can be seen in the foreground of Fig. 2. Trailing from the torpedo is a plug consisting of a number of woollen strands which form an effective air seal irrespective of the shape of the tube. Behind the magnet stand in Fig. 2 can be seen the drying bench where excess moisture is wiped off the tube by cotton waste, behind that again a set of draw belts and in the background the cooling tank, extrusion machine and granule drier.

The next operation is to cut the tube to the required length, and for this it is fed by two spring-loaded gripping rollers, as in Fig. 3, to the knife, the timing of which is controlled by the movement of the rollers. The severed portions fall on to a grooved conveyor which can be seen in the background of Fig. 3 and in Fig. 4; the conveyor leads them to the rotating printing unit where the two colours are printed in rapid succession. Drying is accelerated by means of directed warm air and infra-red lamps. The printed tube lengths are then fed mechanically, four at a time, to a revolving turntable, where the bases are press moulded from strip and cemented in place. The tops are also swaged inwards to facilitate the subsequent fitting of the lid. Finally, the containers are ejected into a conveyor belt (foreground, Fig. 4) for inspection and packing. The caps are press-moulded from extruded strip in the same manner as the bases.

The process described above is followed in general in the case of other extrusions done at the works. Among these are included capillary polythene tubing for ink containers in ball-point pens and unplasticised PVC tubes for water and gas pipes. Polythene is also now extruded as pipes up to 12 in. in diameter, and has been approved by the Metropolitan Water Board for use as domestic water pipes. Apart ftom its lightness and flexibility, polythene has the great advantage that it will expand to accommodate the expansion which occurs when water freezes, and therefore will not burst during frosty weather. Indeed during the last winter, there were not any bursts reported in all the 5,000 miles of piping that have been laid.

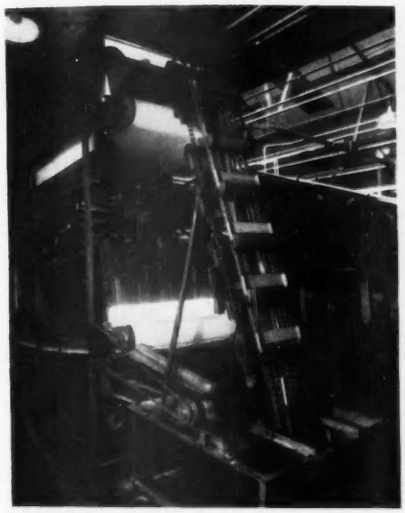


Fig. 1 It is essential that the granules of plastics should be dry before they enter the extrusion machine. They are therefore passed under two sets of infra-red lamps before being fed to the hopper.

Fig. 2 The shape of the extruded tube before solidification is maintained by air pressure. To prevent air escaping a travelling plug is held inside the tube by an electro-magnet; one can be seen on the pedestal in the foreground.

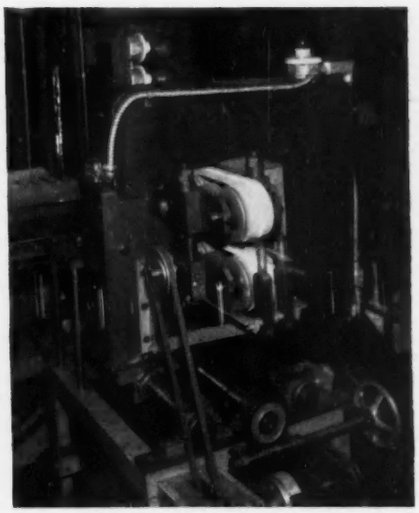


Fig. 3 The tube is fed to the cutter by spring-loaded rollers and the length of the off-cut is measured by the roller movement. The pieces are carried to the next process by the conveyor behind the machine.

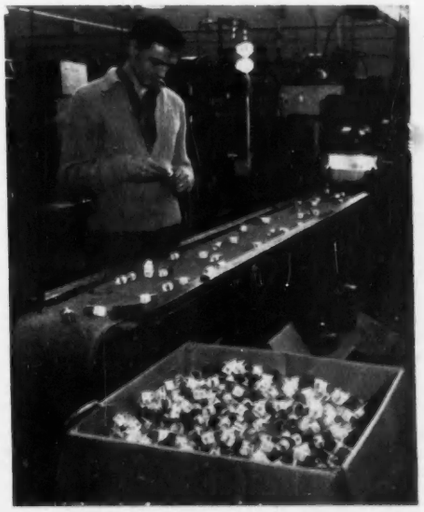
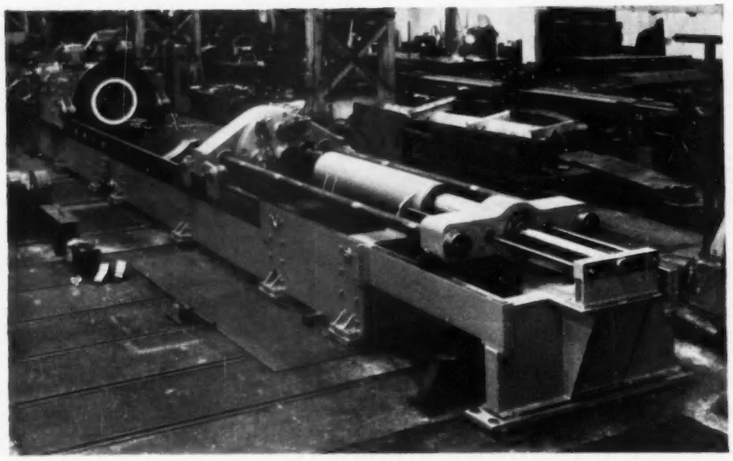
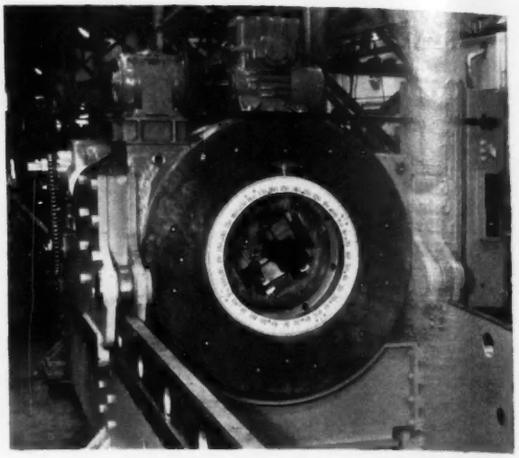


Fig. 4 The cut lengths have the label printed on them and then the bottoms are affixed as the tubes are moved on a turntable. The complete containers then pass to an inspection belt before being packed and dispatched.



Stretching and de-twisting of extruded aluminium sections can be carried out on this single Bigwood machine. Hydraulic power is used. Sections that will fit in a 10 in. diameter circle can be handled in lengths up to 50 ft.



One of the two gripping heads is adjustable along the machine bed to allow for section-length variation. This head also carries the power-operated de-twister.

RECTIFICATION OF EXTRUDED ALUMINIUM SECTIONS

STRETCHING AND DE-TWISTING ON ONE MACHINE

In the extrusion of aluminium and light alloy sections, residual stresses set up during the passage of the metal through the die, and irregular cooling, either in air or in the quenching medium, cause deformation both longitudinally and in the section forms themselves. Consequently, considerable rectification, either by hand or with the aid of powered equipment is necessary. Stretching machines have been used for many years to straighten sections longitudinally and improve the strength properties of the material by loading it up to or beyond its elastic limit. This treatment does not correct the section form itself, and roller-type correcting machines are usually employed for this purpose. In the more complex sections, however, there may also be a regular or irregular twist along the length of the section; light sections can be corrected by hand, but the heavier ones require mechanical equipment.

The conventional arrangement is to have two machines, a stretcher and a de-twister. The latter may be of the vertical or the horizontal type, the horizontal being more convenient to operate. Such an arrangement of two separate machines is useful where only occasional de-twisting is necessary, or where it is possible to organise consistent batch work.

The disadvantages of the two-machine layout are obviated by the combined stretcher and de-twister which has been designed and built by Joshua Bigwood and Son, Limited, Wolverhampton. This machine will deal with sections which can be enclosed in a circumscribing circle of 10 in. diameter, and 50 ft. in length. Provision has been made to lengthen the bed to accommodate longer sections should this be necessary in the future. Basically, the machine consists of a fabricated steel bed which carries two grip-heads. One of these heads is adjustable along the bed to suit sections of various lengths; it also carries the power driven de-twister. The other head is connected to a hydraulic cylinder which provides the stretching load. The hydraulic fluid is water, taken from the shop main at 3,600 lb. per sq. in. No hydraulic pumping equipment is therefore necessary; this could be supplied with the machine for installation where a shop hydraulic line was not available. Stretching speed is infinitely variable under the control of the machine operator between limits of 6 and 60 in. per minute.

The fabricated steel bed, on which the two grip-heads and the cylinder assembly are carried, consists of two heavy slab-type frames, cross-braced at intervals by fabricated cross members. The bed is designed to transmit the de-twisting loads from the grip-heads. The top faces of the side frames, on which the grip-heads move, are fitted with renewable wearing strips. Similar provision for replacement without extensive dismantling, after a long period of service, is made with removable anti-torsion guides on the side frames.

At short intervals along the side frames there are holes in which anchor pins carried on the adjustable head engage. These anchor pin holes are bushed with renewable, hardened and ground steel liners, which are chromium plated to lessen the risk of scoring. The adjustable head is locked in the appropriate position on the bed by the anchor pins when stretching, and can be moved along the bed when the pins are withdrawn. The pins have tapered nose-ends to facilitate entry into the anchor holes. Operation of the pins is by solenoid-controlled air cylinders. Movement of the adjustable grip-head along the bed is by a 5 h.p. electric motor, under the control of push-buttons. The arrangement of bed, grip-heads and locking gear gives an appreciable increase in the height of the pull-line over machines with the conventional hook and rack system of adjustment, and so facilitates the loading and unloading of the extruded sections.

APPLYING THE STRETCHING LOAD

The hydraulic cylinder which applies the stretching load has a stroke of 60 in., and is machined from the solid to ensure soundness. It is mounted on heavily-braced cross-members on the bed and connected to the grip-head by a steel crosshead and two heavy steel drawbars. The weight of the main ram and crosshead is carried by rollers working on an extension of the main frame. The ram is sealed by phosphor-bronze gland rings and special packing rings, and the ram itself is treated to resist corrosion, as the working fluid is water. Return of the grip-head is by a secondary ram working within the main ram, and also actuated by water pressure from the shop main. A high-capacity relief valve is incorporated to eliminate the excessive shock pressure in the return system and so prevent damage to the pipework if an extruded section should break while being stretched.

The grip mechanism on each head is similar, and is designed to accommodate a wide range of sections. Four opposing blocks work in inclined slides in the steel head, the bottom and one side grip-block being manually adjustable by hand-wheel and screw gear, while the opposing side and top grip-blocks are operated by compressed air cylinders. Serrated gripping jaws, flat faced or shaped as required, are attached to the grip-blocks. The gripping position is set by the two manually-adjusted grip-blocks; final gripping is by the two air-operated blocks.

DE-TWISTING

On the adjustable head, which travels along the bed, the grip-jaws are carried in a rotatable member, which is driven by a 7½ h.p. electric motor mounted on top of the head. Special radial and circumferential bearing rollers are used to transfer the main stretching and radial de-twisting loads from the inner rotating member to the housing. The adjustable head is gapped to allow the section to pass completely through it, and the head can therefore be traversed over the section as required. Rectification of twist is not normally done under full stretching load, but the design of the machine is such as to allow it to be done if necessary. A circumferential scale graduated in degrees is fixed to the front of the head, so that the operator can see the amount of twist applied to the section.

The electrical supply to the adjustable head is through flexible cables leading to spring reels on the head. Air from the works mains is piped along the machine bed, and quick-action Schrader couplings are fitted at intervals. A flexible hose is used between the head and the nearest coupling.

A push-button panel is attached to the adjustable grip-head, and from this position the operator controls the de-twisting and traversing motors on the head, and the solenoid air valves for the anchor pins and the grip-blocks. A red indicator lamp on this panel shows the operator at the main stretching control panel near the main ram when the anchor pins are engaged in the holes in the bed. A pressure gauge near the main valve indicates the load applied when stretching.

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DIESEL ENGINE UNDERWATER

A six-cylinder Diesel engine has been constructed to run completely submerged in water, and regularly does so in the instruction school of F. Perkins, Limited. The engine is one of the P.6 models and is mounted in a steel-framed glass-sided 400 gallon tank. It can be stopped or started while submerged and both starter motor and dynamo function normally. Four pipes project above the surface of the water, for the air inlet, and exhaust, and for the fuel and lubricating oil feeds.

HISTORIC ENGINES AND MACHINES IN THE MIDLANDS

NEWCOMEN SOCIETY SUMMER MEETING

The summer meeting of the Newcomen Society took place in the Midlands from May 29 to June 2, and with Birmingham as headquarters a varied programme was arranged for the party of about 50 members and guests who attended. An informal meeting in the evening of the first day gave an opportunity for the programme to be discussed, the full round of activities only commencing on May 30, when the party made an excursion into Worcestershire.

Travelling first to Belbroughton, near Stourbridge, a call was made at the works of Isaac Nash Belbroughton, Limited, where by permission of the manager, Mr. D. S. Wintle, the process of scythe making was seen. The trade is an old one in Belbroughton, scythe makers being recorded there as early as 1520, and the siting of the works was seen to have been originally based on water power, which was, in fact, still used there to a limited extent until recently. About half a mile from the Belbroughton works is Middle Mill, belonging to the same firm, and the party proceeded there to see the last water-wheel driven tilt hammer at work in the Midlands. This hammer is engaged on scythe "plating," that is, hammering out to the approximate finished width the composite bars welded in the main works. An abandoned water-driven grinding mill on the same site was also seen; grinding of scythes and other edge tools had already been shown to the party in an electrically-driven shop at the main works.

LICKEY INCLINE

The next visit was to Bromsgrove where, from a convenient overbridge, the party viewed the Lickey Incline on the Birmingham-Gloucester line of British Railways. Here Mr. Charles E. Lee, F.R.S.A. (Vice-President), gave a short talk on the history of this incline, which is two miles four chains long, with a gradient of 1 in 37, and was the source of many problems in the early days of the railway. All trains ascending the incline are assisted by one or more locomotives at the rear, and the party saw the Bristol-Newcastle train, banked by two 0-6-0 tank engines, start its run up from Bromsgrove.

The afternoon was spent at Worcester, where visits were made to the works of the Worcester Royal Porcelain Company, Limited (by permission of the company), to The Greyfriars, a Fifteenth Century half-timbered house (by permission of Mr. Matley Moore), and to Worcester Cathedral (by permission of the Dean and Chapter).

In the evening there was a special display of selected drawings and correspondence from the Boulton and Watt Collection at the Birmingham Reference Library, which had been arranged by Mr. V. H. Woods, F.L.A., City Librarian. Many different aspects of the lives of Boulton, Watt and Murdock, and of the work of the celebrated Soho Manufactory and Foundry were illustrated by the documents on display, and Miss W. Payne, F.L.A., who is in charge of the collection, was present to answer the many questions asked by members.

May 31 was devoted to visits in or near to Birmingham, starting with one to St. Mary's Church, Handsworth, where, by permission of the Rector, the Reverend J. C. H. Tompkins, M.A., the party assembled to hear a short eulogy of the three men of Soho, Matthew Boulton, James Watt and William Murdock, which was delivered by the President, Mr. A. Stowers, B.Sc., M.I.Mech.E., A.M.I.C.E., A.C.G.I. The party then took the opportunity to inspect the Chantry statue of Watt, the Flaxman bust of Boulton, and the bust of Murdock which are in the church.

Some time was then spent in the Birmingham Museum of Science and Industry, where the party were received by Dr. Mary Woodall, F.M.A., Director of the City Museum and Art Gallery, and Mr. N. W. Bertenshaw, B.Sc., A.M.I.E.E., A.M.I.Mech.E. (member), Keeper of the Museum, who explained briefly the work which he and his staff had in hand, and then guided the party through the arms and long galleries, the engineering hall and the transport section, all of which have been the subject of descriptive articles in ENGINEERING. An item which was not on the official programme came as a pleasant surprise for the party. This was the first steaming of a Ruston Proctor 12 n.h.p. portable engine which has been re-conditioned by Mr. A. J. Kent, a local engineer, in his spare time, and will be placed in the museum collection. The party were shown part of the museum which is not yet open to the public, where some interesting machine tools are in store, and also saw the preparations which are being made to install a Pollitt and Wigzell 100 h.p. tandem compound Corliss engine of 1907, in the engineering hall. The visit concluded with a demonstration by Mr. C. H. H. Franklin, B.Sc. (member) of some of the electrical equipment formerly belonging to Sir Oliver Lodge, and now the property of the museum.

A visit to the Netherton Ironworks, Dudley, of N. Hingley and Sons, Limited, had been arranged as the next item on the programme by Mr. P. Jump, M.I.Mech.E. (member), a director of the company. In the works the party were shown the production and rolling of wrought iron, and the manufacture of wrought iron chain. A beam engine of about 1860, with a bore of 44 in. and a stroke of 7 ft., giving 398 h.p. at 18 r.p.m. was also seen at work driving a rolling mill; this engine is soon to be superseded by an electric drive. The party also saw a small vertical engine which was formerly used at another of the company's works, and has now been preserved at Netherton, where it can be run on compressed air. This engine has the Matthew Murray cycloidal straight-line motion, as patented by Murray in 1802, and is generally believed to be one of the only two remaining engines of its type; the other is in the Ford Museum at Detroit, U.S.A.

The last visit of the day was to the Bilston Iron and Steel Works of Stewarts and Lloyds, Limited, where Mr. W. M. Larke, B.A., M.I.S.I., the general works manager (member), received the party and took them to see a number of blast furnace blowing and electric generating engines running on blast furnace gas. These engines are all Premier positive scavenge type, designed by J. H. Hamilton, who introduced this principle. There are 19 engines, varying in size from 2,000 h.p. to 350 h.p., the two largest engines being for blast furnace blowing, and having four horizontal gas cylinders and two vertical blowing cylinders. All the engines date from the early part of the present century, the oldest one, a 1,000 h.p. tandem blowing engine having been installed in 1903.

THE "BEETLE"

The annual dinner of the Society took place at Kunzle's Restaurant, Birmingham, in the evening of May 31, and instead of a paper to follow the loyal toast and the customary toast to the memory of Thomas Newcomen, Mr. P. Jump showed a selection of short films taken in his company's works. These recorded the production of wrought iron and wrought iron chain and the manufacture of a single-arm mooring anchor. The latter was of particular interest as it showed the old process of building up an anchor from wrought iron by welding piles to produce the size and shape required, and no less than eight strikers were seen at work on a single weld. It also showed the use of the free-falling hammer known locally as the "beetle." The process was last used in the Midlands in 1938, and the film is therefore of considerable historical interest. It is satisfying to know that arrangements have been made for copies of all the films shown to be preserved in the Birmingham Museum of Science and Industry.

The last full day of the meeting, June 1, was spent principally in Shropshire. After a brief inspection of the cast iron bridge dated 1818 at Coalport on the River Severn, the sites of the Coalport China Works and the Coalport Canal Incline (completed 1792, abandoned 1902) were pointed out, as the party proceeded to Ironbridge. Here the history and principal features of the celebrated cast iron bridge of 1779 (the first in the world) were the subject of a short talk by Dr. S. B. Hamilton, O.B.E., M.Sc., M.I.Struct.E., M.I.C.E., A.R.C.S., Past President. The bridge, which is scheduled as an ancient monument, was then examined by the party.

Passing on to Coalbrookdale, the party visited the works of the Coalbrookdale Company, Limited, where, by permission of the company, they saw the ruins of a blast furnace dated 1777 and believed to have been erected by Abraham Darby III to make the iron for the iron bridge. The furnace has been disused for more than a century, and it is not now complete, but sufficint remains, including cast iron beams with "Abraham Darby 1777" cast on, to render it of particular interest. Another beam with the initials EWB and the date 1658 shows that Darby either re-built an existing furnace or used some old parts in the construction of his new one.

The next visit was to the Prior's Lee blast furnaces of the Lilleshall Company, Limited, near Oakengates, where the company had given permission for two steam blowing engines to be examined. The earlier of these two engines is of the simple beam type, with two beams, two cylinders, and two blowing cylinders (it could really be described as a pair of engines with a common flywheel). It was built in 1851 by Murdock Aitken and Company, Glasgow. The steam cylinders are 38¾ in. in diameter and the blowing tubs 78 in. in diameter. The beams are equal-armed and the stroke of both steam and blowing cylinders is 7 ft. 10 in. The engine ran until 1900, when it was superseded by a larger engine of the Lilleshall Company's own design and construction. This engine, also seen by the party, was in turn superseded by turbo-blowers in 1952, but like the 1851 engine it remains in full working order. It is a vertical compound engine, with h.p. cylinder 42 in. in diameter, l.p. cylinder 70 in. in diameter, and a stroke of 5 ft. The two 95 in. blowing tubs are in tandem on the tops of the steam cylinders. At 100 lb. per sq. in. boiler pressure and 19 r.p.m. the engine is recorded as having given 401 i.h.p.

BEAM PUMPING ENGINE

The final visit of the day was to Ocker Hill, Tipton, where, by permission of British Waterways, the party saw the beam pumping engine built by Boulton and Watt for the Birmingham Canal Navigations pumping station at Smethwick in 1777, and removed in 1898 to its present site for preservation. With a 20 in. cylinder and a stroke of 5 ft. 9 in., the engine gave a duty of 18 million in 1778, when tested by Smeaton. It was appropriate that the party should visit this engine, for it was immediately following a visit to it in 1919 at the James Watt centenary celebrations that the late Mr. Arthur Titley first suggested the foundation of a society which not long afterwards was in fact founded by him, and given the name Newcomen Society.

On the following day, June 2, there was a special visit to the private collection of traction and portable engines owned by Mr. F. P. Middleton at Hartlebury, near Stourport, Worcestershire. Here the party saw a number of fine engines including a Humphries portable which was running very smoothly on only 10 lb. of steam, a Burrell 5 ton steam tractor built in 1928, the last year of the firm's existence, and a Burrell showman's engine of 1924 which was in steam.

The use of 136 short tons of aluminium in the S.S. "Sunrip" has increased her deadweight capacity by 200 short tons. The increased cost will be recovered in eight years.

ALUMINIUM IN SHIP CONSTRUCTION

ECONOMY OF WELDING

Being relatively heavy materials, bauxite and alumina offer special problems in sea transport. Carrying them, a vessel can always be loaded to its full deadweight capacity before the available cargo space is full. This loading can be done on each trip to the smelting centre, but the return trip has to be made in ballast unless an assorted cargo can be picked up.

S.S. Sunrip, built by Davie Shipbuilding, Limited, of Lauzon, Quebec, and owned by the Sun Steamships Company, is believed to be the largest ocean-going freighter built in Canada. She is operating under long term charter for Saguenay Terminals, Limited, carrying raw materials for the Aluminium Company of Canada at Kitimat. She has now been in service for over a year and has given satisfactory performance. The main dimensions of the vessel are: Length b.p., 450 ft.; moulded breadth, 62 ft. 6 in.; depth to upper deck, 40 ft. 8 in.; draught, 29 ft. 2¾ in.; deadweight, 12,825 tons; lightweight, 4,340 tons. The vessel is shown in the accompanying illustration.

Machinery spaces are amidships, and propulsion is by geared steam turbines driving a single screw. The ship is of closed shelterdeck design with a short forecastle. The superstructure consists of mast houses, midship houses and after house, and it is mainly in these structures that the weight-saving has been achieved.

The total cubic capacity of 621,115 cub. ft. (of which 493,286 cub. ft. are the actual bulk cargo capacity for alumina) gives a ratio of 12,300 deadweight tons in the holds and feeders to a total of 12,825 deadweight tons. The deadweight to displacement ratio of 0·755 was achieved through careful design and through the incorporation of 136 short tons of aluminium which decreased the lightweight of the ship and added 200 tons to the deadweight.

There is still ample room for greater use of aluminium since 127,829 cub. ft. of unused cubic capacity represent about 3,220 tons and any further decrease in lightweight up to that amount, if it were physically possible, would represent increased earning power.

The quantity of aluminium incorporated was what appeared to be practical in the light of costs and experience, and which could be justified economically at the time of conception of the ship. The question of welding versus riveting was quickly solved; the midship house if riveted weighed 70 short tons and its cost was estimated at 146,000 dols., giving a weight ratio of aluminium to steel of 0·417 and a weight saving of 98 short tons at a premium of 74,000 dols. The same structure welded weighed 59·5 short tons and gave a weight ratio of aluminium to steel of 0·354 and a weight saving of 109·5 short tons for a premium of 46,500 dols.

Redesigning of the welded superstructure by Burness, Kendall and Partners in the U.K., with plates calculated to the nearest hundredth of an inch, saved an additional six short tons. The midship house as constructed finally weighed 64 short tons, giving an aluminium to steel ratio of about 0·38 to 1·00 and a weight saving of 104 short tons for a premium of 37,834 dols. The welded midship house was 20 per cent. lighter and 21 per cent. less costly than the riveted one.

Similar savings were achieved in the aft house, but the mast houses could not be designed to such a saving since the masts and booms were to be in steel. Aluminium has been extensively used for deck beams, girders, hatch boards and hatch beams, trunking and piping, window frames and for lifeboats and their davits, also for many other miscellaneous items such as ladders, awning supports, flooring and walkways.

Argon tungsten arc equipment was used to weld the joints, and almost all welds were made continuous, with some exceptions in the attachment of internal stiffeners to the watertight boards and of beams to weather deckheads in parts of the superstructure. Welds were designed and completed so that at no time did a weld start or finish where stress might concentrate. Welded fillets were placed near the neutral axis of sections wherever this was possible. Where dissimilar metals were joined precautions were necessary to avoid galvanic corrosion. In the S.S. Sunrip all such joints have been isolated. In addition, the outside surfaces of joints in the superstructure have been painted. A certain amount of pre-fabrication was carried out, as for example the captain's bridge deck, which was made in one piece in the shop and then erected on the ship. The longitudinal girders were fabricated from plate, but the deck beams were extruded sections.

The insulating compounds used were synthetic rubbers in liquid form and also as sheet or tape. So far there is no conclusive evidence as to the relative advantages of the liquid or sheet type. An example where isolation is believed to have given very successful results has been in the piping system which has given no trouble at all.

Nearly all the aluminium exposed to the weather has been left unpainted, the only maintenance expected is the washing of the surfaces with a soap solution and bristle brooms. The savings from decreased paint maintenance are expected to be substantial, but methods of finishing must be developed that cost less than the application of the original paint system.

The most obvious way of justifying the added expense, and also the most convincing, is the increased earning power of the vessel, due to the greater deadweight. It is estimated that, running from Jamaica to Kitimat, the extra cost of the aluminium in the superstructure will be covered in about eight years, and thereafter extra income will be produced during the life of the ship amounting to approximately 100,000 dols. by the saving in weight of the superstructure alone.

The information on which this article is based was supplied by the Northern Aluminium Company, Limited, Banbury, Oxfordshire.

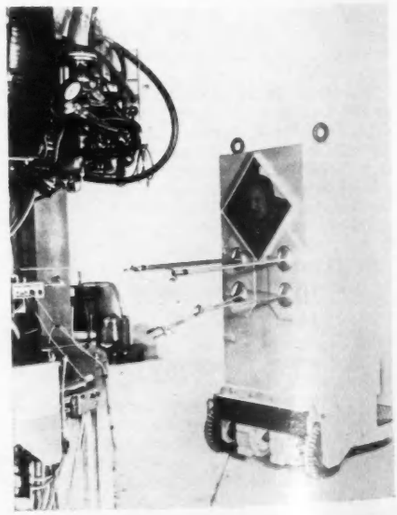
MOULDED MATERIAL GIVING RADIATION PROTECTION

Cold-Setting Lead-Cement

A new radiation shield makes use of lead in a novel form, viz., a cold-setting lead-cement mixture, in addition to the more conventional employment of the metal. In order to enable personnel to transfer radioactive materials without the use of a cave, and to approach the cyclotron target area while the magnet is on, the Argonne National Laboratory at Lemont, Illinois, U.S.A., has developed a mobile shield which has a 4 in. thick lead shield with a non-magnetic stainless-steel skin. Large enough to hold two observers or one operator, it is mounted on a battery-powered chassis and is equipped with a window of heavily-leaded glass for viewing, and ball-joint manipulators for remote handling. It was in the construction of the ball-and-socket joint that there arose the problem of how to construct a joint from a high-density material, such as lead, that would function properly and at the same time prevent entry of harmful radiations. Cast metallic lead proved unsatisfactory, nor was any other material available having a high enough density.

The problem was solved through the development of a cold-setting lead-cement mixture which could be poured into simple wooden forms around the balls themselves. The mixture is poured cold and sets to a cement-like consistency with a density of between 515 and 525 lb. per cubic foot (cast lead has a density of 707 lb. per cubic foot). The composition of the mixture is given in the table at the top of the opposite page.

The water and cement are first mixed to a slurry, after which the lead powder is added while stirring continuously; lead shot is then worked in to form a uniform dispersion. The mix sets slowly, permitting small batches to be



This shield gives protection when approaching highly radioactive sources. The ball-and-socket joints of the manipulators are made of a cold-setting lead-cement easily formed in moulds.

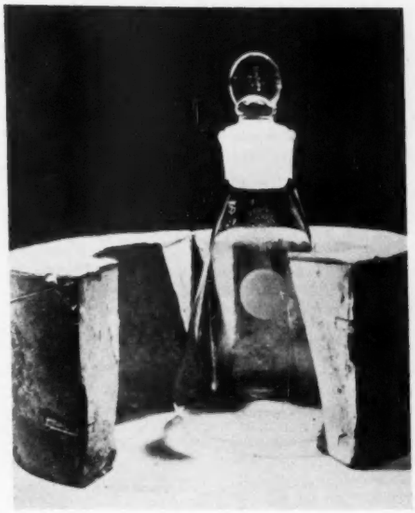
—	Wt., per cent.
Lead shot, [illegible] maximum diameter, ballast type	76
Lead powder, 100 mesh	17
Cement, expanding type	5
Water	2
Aerosol (for better wetting)	Trace

conveniently poured. The forms can be constructed of wood, fibre, metal or plastics coated with parting grease, and are removed from 16 to 24 hours after pouring.

Rotating parts cast into place are grease coated and rotated free within 8 to 12 hours of pouring. The balls or rotating parts should not be oiled as this will cause them to bind. If the rotating parts are not moving freely, the grease should be removed and a creamy slurry of water and a special lapping compound is applied to the moving parts. After working the parts, the excess is wiped off and these parts will work freely without oil.

The compression strength of the mixture after setting for 30 days ranges from 2,200 to 2,500 lb. per square inch. Shielding properties are approximately 1½ times as effective as steel for gamma-ray energy up to 1·33 MeV.

The ease and speed with which the material can be cast in forms has suggested other applications where special shapes are required for radiation shielding, such as the laboratory flask shield which is illustrated herewith. The lead-cement will bond with lead in its more customary forms of sheet, and with brick and glass to form an effective low-cost radiation protection.



The lead-cement is easily moulded to form a shield for flasks containing radioactive products.

Iron and Steel Institute Spring Meeting (*concluded from page* 464)

LOW-TEMPERATURE AND IMPACT PROPERTIES OF STEELS

The afternoon of Thursday, May 17, at the Annual General Meeting of the Iron and Steel Institute, held in London from May 15 to 17 was devoted to the presentation and discussion of six papers, the first four of which dealt with the behaviour and properties of steels at low temperatures and the last two with the impact properties of various steels.

STEELS AT LOW TEMPERATURES

The four papers on steels at low temperatures were all contributions from the Armament Research and Development Establishment of the Ministry of Supply, at Woolwich, and the first was entitled "The Stress/Strain Curves of Some Metals and Alloys at Low Temperatures and High Rates of Strain," and was by Mr. H. G. Baron. He stated that comparative tensile tests had been carried out on a number of metals and alloys at temperatures of 20 deg., −78 deg., and −196 deg. C., using strain rates of 10^{-3} and 10^{+2} in. per in. per sec. The materials examined comprised Armco iron, mild steel, a 0·34 per cent. carbon steel, two 2·5 per cent. nickel-chromium-molybdenum steels, a stainless steel, an aluminium alloy of the Duralumin type, a tough-pitch copper and a leaded brass. The strain rate and temperature had a marked effect on iron and the softer ferritic steels. In dynamic tests below a critical temperature, all the ferritic materials exhibited a type of premature failure in which the strain was entirely localised to a short neck. It was found that this was a consequence of the adiabatic nature of this test. The variation of upper yield stress with temperature and strain rate appeared to obey an activation energy relationship over part of the range of stress. The divergence from theory at low stresses might be due to simultaneous strain-ageing, while, at high stresses, brittle fracture or twinning eventually intervened before the upper yield point was reached.

The Duralumin-type alloy showed a yield point which varied with strain rate and temperature in a manner similar to the steels, but anomalies which were again probably caused by a strain-ageing process had been found in slow tensile tests at 20 deg. C. With annealed tough-pitch copper, the proof stress appeared to be little affected by strain rate and temperature but the rate of strain hardening was strongly affected by both. The strain rate had relatively little influence on the behaviour of annealed brass.

"Yield Behaviour of Metals at Low Temperatures, with Particular Reference to Some Carbon and Low-Alloy Steels," was the title of the second paper. It was by Mr. H. F. Hall and Mr. R. W. Nichols. They stated that they had determined the tensile and impact properties of a series of carbon steels in the quenched and tempered, furnace-cooled, and as-rolled conditions at temperatures between +200 deg. and −197 deg. C. Similar tests had been also made on three low-alloy steels, a pure copper and a Duralumin-type aluminium alloy.

The proof-stress values for the steels had been found to increase markedly with decrease in temperature, this increase being greater in those materials having the lower room-temperature proof-stress values. For most of the materials tested, decrease in temperature also increased the difference between the upper and lower yield point, the yield extension, the elastic modulus and the ultimate stress. The breaking-stress values showed maxima at the temperatures at which maximum elongation occurred.

The tensile and impact properties had been compared and it had been found that the room-temperature reduction in area provided some index to the Charpy maximum energy of a material, but there was no correlation between any of the tensile properties and the impact transition temperatures.

The author of the third paper, "The Hardness of Some Carbon and Low-Alloy Steels at Low Temperatures," was Mr. R. W. Nichols. He stated that in order to determine the effects of low temperature on various proposed relationships between hardness and tensile properties, tests on four specimens of carbon and four specimens of low-alloy steels had been made at +18 deg., −70 deg., and −196 deg. C. The diamond-pyramid hardness number was approximately proportional to the tensile stress at 8 per cent. strain throughout these tests, whereas the ultimate tensile strength: diamond-pyramid number ratios for several of the steels were smaller at −196 deg. C. than at the higher test temperatures. This was partly due to reduced initial rates of strain-hardening in these steels at −196 deg. C., which were also revealed in lower Meyer indices obtained from ball-hardness tests at this temperature. At all temperatures, stress/strain curves, calculated from the ball-hardness test results, showed good agreement over the range 4-8 per cent. strain with comparable curves obtained directly in tension tests.

Mr. R. W. Nichols was again the author of the fourth and last paper, which dealt with "The Mechanical Properties of Carbon-Steel Wire at Low Temperatures." He stated that tensile, impact, fatigue, and reverse bend tests had been made at temperatures ranging from +20 deg. to −60 deg. C., on 0·044 in. diameter carbon-steel wire similar to that used in wire-rope manufacture. The materials contained 0·5 per cent. and 0·75 per cent. of carbon and each was tested in the annealed, as-drawn, and electro-galvanised condition.

The proof-stress and ultimate tensile-stress values in the tensile tests had been found to increase with decrease of temperature, while the tensile reduction in area and notch-bend impact energy values decreased. These effects were relatively small at temperatures down to −60 deg. C. In the fatigue tests the endurance limit increased with decrease of temperature except for the electro-galvanised materials, which showed decreases in endurance limit associated with crack formation in the zinc coating.

Endurance tests at applied strains of up to 5 per cent. had been carried out by reverse-bending around formers. At each temperature the rate of decrease of endurance with increase of applied strain became markedly greater when the deformation became predominantly plastic. Within this higher strain range, a decrease of temperature produced a deterioration in specimen life at a given strain level for all the materials. The reverse-bend properties for the electro-galvanised wires were superior to those for the as-drawn at +20 deg. C., but showed a greater deterioration on cooling to −60 deg. C., especially when the results were compared on an equivalent stress basis.

DISCUSSION

Dr. N. P. Allen, F.R.S., said that there had been a great deal of interest shown recently in the properties of metals at low temperatures, and, as often happened the particular figure wanted had always been missing. Dr. Northcott's laboratory had now obtained the data that were required. Hence these papers would provide a standard of reference for a long time to come.

Some eight or ten years ago, when brittle fracture first came to the fore in the metallurgical world, it was very common for metallurgists to be told that it was all due to the crossing of the brittle-stress curve by the yield-stress curve, and that there was good theoretical reason to suppose that the first would be independent of temperature. In the light of the evidence, the fact must be accepted that the brittle fracture stress was not independent of temperature. Mr. H. F. Hall and Mr. R. W. Nichols had found this to be so, and it had been found to be so at the National Physical Laboratory. Moreover, supporting information had been found in the literature. It had been ascertained that the variation of brittle-fracture stress with temperature was not always the same.

Lt.-Commander G. K. Rylands said that when considering notch-impact test results one should be certain that one was comparing like with like. Thus, the structure of the wires before drawing should be known, i.e., whether it was purely sorbitic or consisted of ferrite-pearlite? In the case of the Haigh-Robertson fatigue test the comparative value at different temperatures was important, but in his experience the value of the Haigh-Robertson fatigue-test result was purely to compare the service condition of the material and it did not give much information about its ultimate performance in a wire rope. Some years ago a suspension bridge had been built in America in which the wire in the suspension strands had admirable fatigue and elastic properties, but it had crashed after a very short life. The wire from which those suspension strands had been made had been replaced by drawn wire of fatigue properties far inferior to the original wire, but the bridge was still in existence to-day. On that basis, it appeared, therefore, that too much reliance should not be placed either on the Haigh-Robertson results or the type of bending test shown in these papers, although he agreed that, from the point of view of comparing what happened at different temperatures, the results were of value.

It was comforting to learn that nothing very much happened to the material at the temperatures likely to be met with in practice, but conditions might alter and wires operating at temperatures of − 60 deg. C. or even − 180 deg. C. might have to be provided. At present, fortunately, that did not often happen.

Mr. G. M. Boyd asked a question regarding the attempts to find a correlation between transition temperatures in notch-impact tests and the tensile test. It was peculiar that very little attention was paid to the character of the fracture in the tensile test itself. The shape of the stress/strain diagram was studied quite closely, but if the type of fracture obtained in a tensile test were examined it would be seen to vary from a long neck with a V at the cone, through a rather more restricted cone with

a shorter neck to the other extreme, where there was a more or less straight fracture across.

At this stage the President asked the authors, owing to lack of time, to reply to the discussion in writing.

IMPACT PROPERTIES OF STEELS

The last two papers considered at the meeting were jointly discussed after presentation; both were concerned with the impact properties of steels.

The first paper was by Dr. N. P. Allen, F.R.S., and Mr. C. C. Earley, of the National Physical Laboratory, and dealt with the " Effect of Phosphorus Content on the Impact Value of Fully and Partially Hardened and Tempered Manganese-Molybdenum Steels." The authors stated that a series of 1·5 per cent. manganese-molybdenum steels approximating to En.16 had been made with additions of up to 0·06 per cent. of phosphorus. In both the fully and partially-hardened conditions, the steels after tempering showed a progressive rise of impact transition temperature with increase of phosphorus content, but the impact transition temperatures of the fully-hardened steels were consistently lower than those of the corresponding partially-hardened steels. Consequently a more complete hardening during quenching was necessary to attain a given standard of tensile strength and impact value in phosphorus-rich steels than in steels of otherwise similar composition but free from phosphorus.

The impact transition temperatures of phosphorus-free steels were not affected by slow cooling from the tempering temperature, but those of phosphorus-containing steels were raised. The addition of molybdenum lowered the impact transition temperature of partially-hardened phosphorus-containing steels, but not of fully-hardened steels free from phosphorus.

The second paper was by Mr. S. J. Rosenberg and Mr. J. D. Grimsley and was concerned with " A Study of the Impact Properties of Boron Treated Steel." It described work carried out at the National Bureau of Standards, Washington, District of Columbia, U.S.A. The authors stated that, 21 steels from the same open-hearth heat and made to a base composition of 0·43 per cent. carbon and 1·60 per cent. manganese had been studied to evaluate the effect of boron on the Charpy V-notch impact properties over the temperature range of −140 deg. to +140 deg. F. The boron which had been added in various amounts by means of seven different addition agents or intensifiers, improved the impact properties of the steels tempered at 400 deg. F., but generally appeared to be detrimental to the impact properties of the steels tempered at 800-1,200 deg. F., and air-cooled. The extent of this detrimental effect depended upon the type of addition agent, the amount of boron, and the tempering temperature. The temper-brittleness of the untreated steel (induced by furnace-cooling from 1,200 deg. F.) was increased when boron was added by five of the intensifiers.

Considering the overall effect of boron, it appeared that this element could be added in amounts up to 0·0025 per cent. in the form of simple intensifiers without significantly affecting the impact properties.

DISCUSSION

Dr. B. C. Woodfine, who opened the discussion, said that the paper by S. J. Rosenberg and J. D. Grimsley raised two important questions of general interest. The first was how the transition temperature, as defined by the notch-bar impact test, should be chosen, and the second was how the effect produced by an embrittlement phenomenon such as temper brittleness on the fracture energy testing temperature curve should be evaluated. Both questions, and particularly the first, had been and were the subject of considerable debate, but neither would be resolved until a closer understanding of the mechanism of deformation and fracture in notch-bar impact specimens had been achieved. Unfortunately, the results obtained in the notch-bar impact test did not refer to a unique property of the material but depended in a very complex manner on the interrelation of yield stress, fracture stress, strain, strain rate, temperature and the stress system, and it should be obvious that the fracture energy/testing temperature curve could not be defined by any one parameter. This point was clearly brought out by the authors, who emphasised the need to consider the curve as a whole. In most cases the same qualitative conclusions in respect of the influence of a given variable on the fracture energy curve would be reached, irrespective of the criterion chosen, and this was probably no more than could be reasonably expected in view of the complex nature of the test.

As it was necessary, however, to reduce the number of criteria in use, he ventured to suggest that the curve should be specified by reporting the maximum temperature corresponding to 100 per cent. brittle fracture, the minimum temperature corresponding to 0 per cent. brittle fracture, and the fracture energies corresponding to these two temperatures.

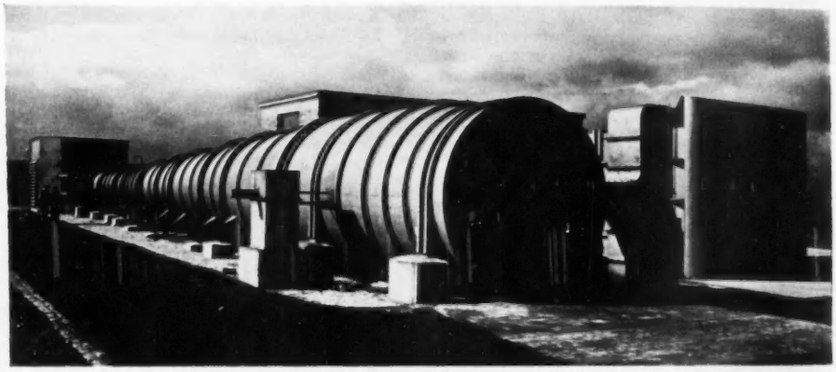
The paper by Dr. Allen and Mr. Earley showed the important effects of small amounts of impurities in steel, and particularly of phosphorus. Phosphorus had normally been suspected of being responsible for most of the troubles in steel, and the more was known about it the more this view seemed to be reasonable.

Mr. G. M. Boyd said that both papers centred round the definition of transition temperature. So far as engineers were concerned, he thought that, ultimately, the criterion must be service performance. In that respect they, at Lloyds Register of Shipping, had made a very earnest attempt to find some correlation between all these different definitions of transition temperature and service behaviour.

There were many cases in which two steels giving almost identical energy levels had a very different fracture appearance, while two steels with the same fracture appearance could have widely different energies. That had led them to study the types of criteria which related best to their experience in service, and they had found that, although the correlation, was by no means 100 per cent., there was undoubtedly a very great bias in favour of fracture appearance as a criterion. The interesting thing about this, moreover, was that the fracture appearance seemed to be possibly the only criterion which was almost insensitive to geometry.

There was, however, one serious drawback to the fracture appearance as a criterion, and that was that it was possible to get a good fracture appearance transition by several means. One of them, perhaps intrinsic, was a function of the composition or microstructure of the metal, and the other was a function of its macrostructure, namely, the distribution of inclusions in the steel. Steel which metallurgically was considered a " dirty " steel, tended to give a very good result on fracture appearance transition.

Mr. C. C. Earley, in a brief reply, said that with reference to the development of intergranular brittleness, a great deal of microscopic examination had been conducted not only on the steels heat-treated in various ways but also on the fractures. The problem, of course, was not only one of fine grain size in these steels, but with steels which had been heat-treated, quenched and tempered there were marked acicular patterns. As a result it was very difficult to examine any sort of grain size as such, and it was very difficult to say whether or not the material was failing in an intergranular manner. Of the fractures that they had examined, they believed that the failure, so far as could be judged, was by cleavage.



The new transonic tunnel at Short Brothers and Harland, Limited, is driven by three Rolls-Royce Nene turbojets exhausting into a conical diffuser acting as an ejector pump. On the right is seen the square bell-mouthed air intake.

OPEN-CIRCUIT TRANSONIC WIND TUNNEL

The first runs of a new wind tunnel for speeds up to Mach 1·2 have recently been made at the works of Short Brothers and Harland, Limited, Queen's Island, Belfast.

The tunnel, which will take models of about 18 in. span, is of the open-circuit type and occupies an area of about 150 ft. by 40 ft. It is driven by three Rolls-Royce Nene jet engines which exhaust into the final diffuser to form an ejector pump. The tunnel structure, manufactured by Harland and Wolff, Limited, Belfast, is of welded steel sections bolted together on erection. The shell thickness varies from ½ in. to ¼ in. depending on the local internal pressure, and is stiffened by T-sections to prevent buckling and " panting."

The structure is securely anchored at four points and has three expansion joints which enable the rest of the tunnel to move axially on rollers. All the supports rest on separate concrete rafts and the rollers are mounted on jacks which allow adjustment of the tunnel height to compensate for possible uneven sinkage.

The three engines are housed in a steel building integral with the second corner. The walls of this building are louvred, and the three engines are erected so that the outer ones are slightly toed in, the centre-lines meeting at the end of the parallel mixing section. The engines are remotely controlled from the observation room by means of Exactor controls. Warning of fire in the engine room is given by an alarm buzzer and the approximate location of the fire is indicated by lights in the control console. Two batteries of carbon dioxide bottles are operated manually by handles on the engine console. Warning lights are also fitted to the console to indicate if any of the access doors are open and it is impossible to start the engines if this is the case.

Air enters the circuit through a bell-mouthed intake, 11 ft. square, which is about 28 ft. upstream of the beginning of the contraction. The latter, 13 ft. 2 in. long, has a contraction ratio of 19·35. It was designed to have an increase in pressure coefficient of 0·08 on the straight walls upstream and downstream of the contraction. Model tests have indicated that it performs satisfactorily.

WORKING SECTION

The working section is 2½ ft. square and has slots on all four walls with an open to total-periphery ratio of 1 to 9. There are 16 slots (width 0·833 in.) and the two central slats in the side walls will later be provided with rectangular windows to facilitate Schlieren observation. The total length of the slots is 6 ft. 1½ in. and it is estimated that the length of uniform flow at M = 1·2 should be about 18 in. The working section is surrounded by a 6-sided plenum chamber, the nearest wall of which is 1 ft. from the wetted face of the slats. The flow through the slots into the plenum chamber is induced by " diffuser suction," and the air returns to the mainstream at the end of the slotted section,

mixing taking place in a parallel sided duct 3 ft. square and about 7 ft. long.

The first diffuser has a mean equivalent cone angle of about 3·8 deg. The final conical diffuser has an angle of 5·2 deg. and an exit diameter of 11 ft. The ejector pump, which is of the constant area type, has an area ratio (primary to secondary) of 0·35 and at Mach 1·2 is working at a mass flow ratio of about unity. The mixing section is 5 ft. diameter and 31 ft. long.

At the end of the final diffuser a transverse duct with a forward-facing intake and an aerofoil-shaped fairing allows some of the hot exhaust gases to flow across to the inlet side. They re-enter the circuit just downstream of the bell-mouth through twin vertical "splitters" fed from above and below. The hot gases mix with the cool air to give an elevated stagnation temperature. This can be varied from ambient to a maximum of about 90 deg. C., which is sufficiently high to prevent condensation at Mach 1·2. Temperature control is effected by means of a by-pass valve near the recirculation intake which allows some of the gases to return to the diffuser while some flow into the inlet through the connecting duct. With the valve fully open, about 10 per cent. of the flow in the diffuser is recirculated.

With wings of large sweep angle the maximum span for interference-free flow at Mach 1·2 is probably about 1 ft., but it may be possible to test straight wings of spans up to 18 in. at this speed provided that the subsonic corrections are not too large. The Reynolds numbers attainable vary from about 4×10^6 per foot at Mach 1·2 to 3×10^6 per foot at Mach 0·6. The performance of the tunnel has been checked by extensive tests on a $\frac{1}{12}$-scale model on which flow observations and pressure measurements have shown that there are no separations in the contraction, the corners or the diffusers.

Models are mounted inverted on a sting support, springing from a simple parallel linkage. The sting is capable of rotation through 360 deg. in roll, the rotary motion and the angle of pitch being servo-actuated. The range of the latter movement is from − 50 to + 20 deg. For the purpose of tunnel calibration, static, total-head and total-temperature rakes may be rigidly mounted on the foremost vertical link.

Forces and moments are measured with conventional strain gauge bridges, the readings being taken on Elliot strain-gauge units mounted in a console. This console will also carry the tunnel temperature control, the dials for setting pitch and roll angles and a Schlieren viewing screen. The strain-gauge balances are calibrated in a rig in which the tunnel operating temperature can be maintained during the calibration. Pressures are measured on mercury manometers and, initially, Mach number will also be measured by this means.

Schlieren and shadowgraph flow observations are to be made using two 18 in. diameter spherical mirrors. Initially the observations will be photographed in black and white on an F24 camera, but the possibility of colour photography on 35 mm. film is to be investigated.

In order to increase the output of the tunnel and reduce the fuel cost per reading, equipment for the automatic recording and reduction of data may be provided. This will involve the provision of digitisers on all measuring equipment and the use of some form of mechanical pressure-measuring device. In order to take full advantage of the possible speed of recording it may also be necessary to provide an automatic Mach number control.

The design of apparatus for the measurement of all oscillatory derivatives is also being investigated and it is hoped that it will be possible to make these measurements on the complete models used for static tests.

ATOMIC REVIEW

Germanium crystal junctions with low leakage velocity for minority carriers—Bore-hole logging: brine saturation in hydrocarbon formations—Level indicator for toxic or radioactive liquid metals—Improved sonic gas analyser—Stabilised power supply for large electromagnet—Three-phase electromagnetic conduction pump for liquid metals—X-ray diffraction unit with single-crystal orienting device—Air surveying for radioactive ores—CERN Annual Report and symposium—A.E.I.-John Thompson reactor for Germany—Symposium on Calder works.

As in previous Atomic Reviews, abstracts of unclassified United Kingdom Atomic Energy Authority reports may be recognised by the Authority's reference classification or the patent specification inserted after each item.

Equipment and Techniques

Contacts can be made to germanium crystals which are largely impermeable to minority carriers but permeable to majority carriers. In the presence of a suitable electric field concentrations of minority carriers can accumulate at such contacts. In other words, junctions between lightly and heavily doped germanium of the same conductivity type (L/H junctions) have a low leakage velocity for minority carriers. This result can be considered as a reduction of the minority carrier mobility and gives rise to enhanced current multiplication in certain structures; for example, filamentary transistors. (J. B. Arthur, A. F. Gibson and B. Gunn. RRE Mema Nos. 1189 and 1190.)

BORE-HOLE LOGGING

The brine saturations in hydrocarbon formations traversed by a bore hole may be determined by a novel method of borehole logging involving neutron irradiation and gamma-ray detection. A known brine-free formation and a known brine-saturated formation are irradiated with neutrons and measurements made of the occurrence and energy of the gamma rays promptly emitted by nuclei in each of the formations. The count rate of the rays is determined as a function of their energy, and an energy range is selected within which the count rates in the respective formations exhibit a maximum differential. The formations traversed by the bore hole are irradiated with neutrons from a source moving through the bore, and the gamma-ray count within the selected range obtained as a function of distance along the bore hole. The count rate is a measure of the brine saturation at any point along the recording instrument's path. (J. L. Putman, D. B. Smith and G. R. Church. Pat. Spec. 22526/55.)

An apparatus has been devised for measuring the level of liquid metals, particularly those which may be reactive or toxic, and is envisaged for use with hot or radioactive sodium or sodium potassium alloy. The instrument comprises a tube capable of functioning as a microwave guide; connections linking the tube with a reservoir containing liquid metal, so that the metal takes up a level in the tube corresponding to the level in the reservoir; an adjustable microwave source; and a microwave detecting instrument coupled to the tube above the level of the liquid (G. S. Light. Pat. Spec. 22092/55.)

An existing sonic gas analyser has been modified to eliminate various faults. The original instrument had a low resolution and ambiguity due to the presence of multiple resonance peaks. To avoid these difficulties a sonic gas analyser was constructed comprising a resonant acoustic cavity fed by a vibratory diaphragm electromagnetically driven. The diaphragm can vibrate freely and there is a flared entry from the diaphragm to the cavity. (E. Duncombe. Pat. Spec. 21215/55.)

A 100 amp. stabilised power supply has been designed to energise a 13 kW electromagnet for use in nuclear and paramagnetic resonance experiments where a constant magnetic field is required. The magnet current can be controlled from 0·2 to 100 amp. This provides a flux density in the gap of the electromagnet of approximately 250 to 12,000 gauss, using flat pole-pieces $1\frac{1}{2}$ in. apart, with a peak-to-peak ripple of less than one milligauss. The system has been arranged to keep the current from 1 to 100 amp. (in two ranges) stable to better than 1 part in 10^5 over a period of 15 minutes. Unfortunately, it has not yet been possible to verify this stability experimentally. The power for the magnet is provided by a direct-current generator driven at constant speed. (R. C. Bowes and E. H. Boyenval. RRE 3004.)

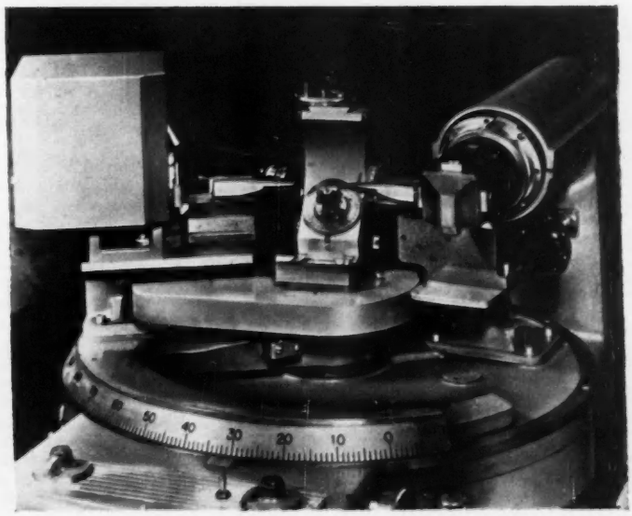
POLYPHASE CONDUCTION PUMP

A three-phase electromagnetic interaction pump of conduction pattern has been developed. The pump comprises a liquid metal duct arranged within the poles of a three-pole iron yoke structure with field coils arranged on the yoke such that when excited by three-phase current a magnetic field is created transversely across parts of the duct in turn. Electrodes are connected to the duct for feeding current across the duct parts and three-phase high-current secondary coils are located on the yoke structure; these are connected to the electrodes so as to feed current across the duct parts substantially in phase with the instantaneous magnetic field in the duct parts. The duct section may form a closed figure or be star shaped to constitute a delta or star connected load. (P. Fortescue. Pat. Spec. 24715/55.)

A low background sensitive phosphor for detecting burst cartridges in the Calder Hall reactors has been developed by the Thermal Reactor Design Committee of the U.K.A.E.A. The effect of temperatures of up to 40 deg. C. on the counting efficiency of three types of β sensitive organic plastics phosphors has been measured. Of those considered, tetraphenyl butadiene in polystyrene was found to be the most efficient, and the least affected by temperature changes. A technique has been developed for making a low background composite phosphor, by shrink-fitting a cylinder of the phosphor into a Perspex light guide. An increase of signal/background ratio by a factor of 2·5, without loss in sensitivity, is attainable in a design for β energies similar in value to those of the daughters of gaseous fission products. (D. J. Skilling. TRDC/P. 129.)

X-RAY DIFFRACTION UNIT

An X-ray diffraction unit developed for the analysis of a wide range of materials has been designed by the X-ray department of the General Electric Company, Milwaukee, Wisconsin. It permits accurate rapid analysis by means of a high-speed proportional counter and pre-amplifier. In this way X-ray diffraction techniques are freed from dependence on conventional Geiger counters. An interesting feature of the apparatus is a single-crystal



The General Electric XRD-5 X-ray diffraction unit, which can be used for the analysis of a wide range of materials, is equipped with a single-crystal orienter, which makes possible the study not only of single crystals but also of wires and fibres.

orienting device, which makes possible the routine identification of organic or inorganic single crystals. It also enables the operator to analyse wires and fibres and to study preferred orientations by the reflection method.

The unit is designed on the building-block principle so that new components can be added as the need arises. The apparatus incorporates a helium tunnel assembly, which greatly extends the range of application for fluorescent analysis, increases sensitivity and permits accurate routine quantitative analysis of such abundant elements as sulphur, chlorine, potassium and calcium. A helium atmosphere is substituted for air in the path of soft X-rays emitted by low atomic-number elements. With this unit counts exceeding 100,000 per second can be achieved, and the count capacity is 100,000,000; this allows direct counts of line area even for very intense wide lines. It is stated that the proportional counter pre-amplifier enables the detector to perform linearly in a range about five times greater than is possible with multi-chamber Geiger-counter assemblies. The response is linear up to about 20 times greater intensities than with typical single-chamber Geiger counters. The proportional counter assembly has less than one microsecond resolving time. Known as the General Electric XRD-5 unit, it is shown in the accompanying illustration, where the single-crystal orienter can be seen.

SURVEYING ORES BY AIR

The search for radioactive ores can often be carried out from the air, and the United Kingdom Atomic Energy Authority have shown how general regional surveys could be made from aircraft flying at 500 ft. or less. Air surveying can be performed by means of a very sensitive scintillation counter mounted, for example, in an Auster aircraft. A large gamma-ray detecting crystal 6 in. across is used, and high counts indicate the presence of radioactive materials.

Announcements

The European Organisation (originally Council) for Nuclear Research (CERN) has recently published its first Annual Report, in which appear details of the history, structure and administration of CERN; an account of research activities and a list of publications and lectures; a break-down of expenditure; and descriptions of the organisation's 25 GeV proton synchroton and 600 MeV synchrocyclotron, both of which are at present under construction. Copies of the report may be obtained from the CERN Information Service, Villa de Cointrin, Geneva Aéroport. CERN is at present holding a symposium on high-energy physics at the Institute of Physics of the University of Geneva. The symposium began on June 11 and will continue until June 23; it is being attended by some 300 scientists from 20 countries including the 12 member states, the U.S.A. and the U.S.S.R. Subjects to be discussed include the design of high-energy particle accelerators, the detection of fast particles, bubble chambers and over compression cloud chambers, the physics of so-called π-mesons, the short-lived particles responsible to a large extent for the binding forces in atomic nuclei, and the recently discovered anti-proton.

MERLIN FOR GERMANY

The Associated Electrical Industries Limited announce that A.E.I.-John Thompson Nuclear Energy Company, Limited, have received an order for a research reactor from the German Ministry of Economics and Transport. The reactor, of the swimming-pool type, will be capable of operating at a heat output of up to 5 MW. This is the second MERLIN (Medium Energy Light-Water-Moderated Industrial Nuclear Reactor) to be built by the company, the other being for the A.E.I. Research Laboratory at Aldermaston Court. The reactor for Germany will be the same as that for Aldermaston in the design of core, reactor tank, control gear and instrumentation and in the experimental facilities provided (see ENGINEERING, April 13, page 220).

The provision of the enriched uranium fuel required does not form part of the contract. The fuel consists or uranium oxide with 20 per cent. uranium 235, the total initial charge of fuel being approximately 30 kg. (6 kg. of uranium 235). The water in the reactor tank acts as moderator, coolant and shield. It is circulated through water/water heat exchangers and back to the tank, a portion of it being by-passed through a filtering and demineralising plant so that the water is continuously "polished." As yet, the question of the secondary cooling circuit has not been discussed in detail with the German authorities and this will no doubt be determined largely by site conditions.

SYMPOSIUM ON CALDER WORKS

The British Nuclear Energy Conference is to hold a symposium on the "Calder Works Nuclear Power Plant" at the Institution of Civil Engineers on November 22 and 23 this year. Among the contributors will be Sir John Cockcroft, Sir Christopher Hinton, Mr. R. V. Moore, Mr. B. L. Goodlet, Mr. P. W. Mummery, Dr. A. B. McIntosh, Mr. W. L. Owen and Mr. J. Eccles. Some of the topics to be surveyed are: the design study for the plant, heat transfer, reactor physics, shielding, metallurgy, the reactor vessel, fuel handling, steam-cycle analysis, heat exchangers, control and instrumentation, and the future development of gas-cooled reactors.

Unfortunately in our article last week (page 474) entitled "Harwell Review," the illustrations for Figs. 3 and 5 were interchanged; the correct caption for Fig. 3 is that given as Fig. 5 and conversely.

FIRE

The recent disclosures by the Parliamentary Secretary of the Ministry of Labour, Mr. Robert Carr, that considerably more than half the factories required by law to have fire alarms were not so equipped and, it may be surmised, were probably lacking in other necessary precautions, as was the mill at Keighley which brought the subject into the limelight—must have been felt by the Fire Research Board to be a disheartening prelude to the publication of their annual report for 1955 (*Fire Research*, 1955, H.M.S.O., price 4*s.* net). What is the use of devoting considerable effort to means of preventing fires and preserving life in the event of fires, if factory managements are too callous and careless to take the reasonable precautions that the law demands and if factory inspectors and local authorities are too negligent—possibly because they are overburdened in their duties—to see that the law is kept ? However, now that this unhappy situation has been brought to light, by the Keighley disaster, it can be hoped that the tightening-up of procedures announced by Mr. Carr will have the necessary effect.

Large sections of industry are, of course, fully conscious of their responsibilities regarding fire hazards, and some 30 per cent. of the work of the Joint Fire Research Organisation is concerned with advisory work and *ad hoc* investigations arising from the inquiries of industry, government departments, local authorities, and individuals. 50 per cent. of their effort is devoted to applied research springing from the advisory work and the remaining 20 per cent. is devoted to background researches on (i) combustion and its suppression, (ii) the behaviour of various materials when subjected to high temperatures, (iii) and the factors affecting the development of fire in buildings.

In the first category, studies of the propagation of flame in complex containers and along ducts, and of the conditions leading to detonation, have been commenced. Into the second category fall studies on the effects of high temperature on the behaviour and strength of concrete, with particular attention to spalling. Calculations on thermal stresses in unevenly heated reinforced concrete beams have indicated that their magnitude may be comparable to those of the loading stresses and may play a major part in determining fire resistance. In the third category is the manner in which the spread of fire is influenced by the design and content of buildings—a difficult subject which it is hoped to solve by means of model studies; whether, in fact, such techniques can be applied awaits the results of current basic work on heat transfer and the movement of hot gases in a building enclosure under various conditions of fire load and ventilation.

INCREASE IN ELECTRICAL FIRES

Notable points in the 1955 report include the steady increase of fires associated with the use of electricity, the number of which appears to be directly proportional to the energy transmitted, and approximates to one fire per 10 million units. Addition of wiring by amateurs to existing installations is one of the principal hazards. Another troublesome source of fire is the spontaneous ignition of sawdust and woodwaste heaps; the height of such heaps, it is recommended, should be controlled and increased in stages, and temperature observations should be made to ensure that the heap is safe from spontaneous ignition.

To study industrial hazards arising from the flammability of dusts, vapours and gases, and to advise on relevant research programmes, the Fire Research Board has set up a committee under Professor A. R. J. P. Ubbelohde. Preliminary tests have already been carried out on an apparatus for studying explosion venting requirements in duct systems.

Related work by the Director of the Safety of Mines Research Establishment includes an investigation into the efficacy of a commercially-developed explosion detector and isolating valve which is triggered by the rate of increase of pressure at an early stage in a developing explosion.

Investigations on the suppression of petrol-fuelled aircraft fires has shown that chlorobromomethane is a superior extinguishing agent to carbon tetrachloride, and that the most effective way of deploying it is in a fan-shaped spray. Accordingly, the Ministry of Supply have prepared a specification for improved fire protection in the Royal Air Force.

For detecting the source of a fire through dense smoke, a detector sensitive to infra-red radiation has been developed, in which a parabolic mirror focuses the radiation on a photoconductive cell capable of detecting radiation from flames or surfaces hotter than 150 deg. C. The signal is applied to give an audible indication. It can detect a candle flame some 60 ft. away and should be a useful portable tool for firemen's use.

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NOTICES OF MEETINGS

Association of Supervising Electrical Engineers

OXFORD
Annual General Meeting. Oxford, Reading and District Branch. Y.M.C.A., 10 George-street, Oxford. Sat., June 16, 7 p.m. (Alteration of date.)

PORTSMOUTH
Open Meeting. Portsmouth Branch. 598 Commercial-road, Mile End, Portsmouth. Tues., June 19, 7.30 p.m.

SOUTHAMPTON
Annual General Meeting. Southampton Branch. Polygon Hotel, Southampton. Thurs., June 21, 7 p.m.

WATFORD
Annual General Meeting. Watford Branch. Compasses Hotel, High-street, Watford, Herts. Thurs., June 21, 7.45 p.m.

Building Centre

LONDON
Australian documentary films: "Plan for Living" (town planning in Australia); "Pageant of Power" (coal and electricity); and "Science and Wood." Wed., June 20, 12.45 p.m.

Institution of Civil Engineers

LONDON
Conversazione. Wed., June 20, 7.45 p.m.

Institution of Mining Engineers

EDINBURGH
Summer Meeting:
"Problems of Coal-Face Mechanisation in the Scottish Coalfield," by Dr. J. H. Paterson and H. H. Wilson, at 11 a.m.
"A Study of British and Continental Methods of Colliery Blasting," by R. F. McCormick and Dr. R. Westwater, at 2.30 p.m. Freemasons' Hall, 96 George-street, Edinburgh, 2. Wed., June 20.
Various visits and excursions. Thurs. and Fri., June 21 and 22.

Royal Meteorological Society

LONDON
"The General Circulation of the Atmosphere: A Numerical Experiment," by N. A. Phillips. Wed., June 20, 5 p.m.*

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. Particulars for this column should reach the Editor not later than Monday morning in the week preceeding the date of the meeting.

* An asterisk is placed where it is understood that tea is available prior to the time stated.

Association of Supervising Electrical Engineers, 23 Bloomsbury-square, London, W.C.1. (LANgham 5671.)
Building Centre, 26 Store-street, London, W.C.1. (MUSeum 5400.)
Institution of Civil Engineers, Great George-street, London, S.W.1. (WHItehall 4577.)
Institution of Mining Engineers, 3 Grosvenor-crescent, London, S.W.1. (BELgravia 3691.)
Royal Meteorological Society, 49 Cromwell-road, South Kensington, London, S.W.7. (KENsington 1993.)

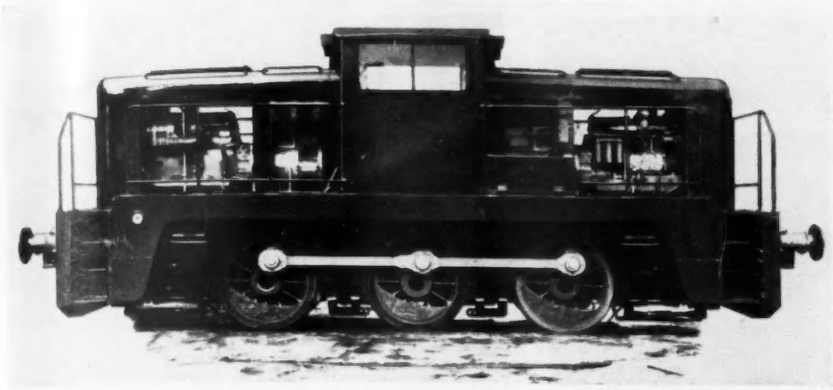

Fig. 1 The "Janus" locomotive has two 200 h.p. Rolls-Royce Diesel engines driving generators which supply two axle-mounted motors. Either set can be shut down if only low power is required. The illustration shows the locomotive with the hood panels removed.

DIESEL ELECTRIC SHUNTING LOCOMOTIVES

INDUSTRIAL DESIGNS OF 200 AND 400 H.P.

One of a new series of Diesel-electric locomotives built by the Yorkshire Engine Company, Limited, Sheffield, was recently demonstrated at the works of the Appleby-Frodingham Steel Company at Scunthorpe. The company at present uses 48 steam locomotives within their works for shunting purposes and for handling ore from the nearby workings, and they eventually intend to replace all of them by Diesels. The new series will be known as the "Janus" locomotives and are being built in two sizes, of 200 and 400 h.p., respectively. They utilise the 200 h.p. Rolls-Royce Diesel engine, the C6SFL, which is a six-cylinder four-stroke supercharged unit with a bore and stroke of 5½ in. and 6 in., respectively. The illustration (Fig. 1) of the 400 h.p. locomotive shows the position of the two engines and their generator sets. British Thomson-Houston electrical equipment is used.

The 400 h.p. locomotive is of the 0-6-0 type and weighs 48 tons in working order. The tractive effort at start is 30,000 lb. and at the continuous rating speed of 8 m.p.h. is 13,100 lb. The maximum permissible speed is 23 m.p.h. The coupled wheels are set at 5 ft. 6 in. centres and are 3 ft. 8 in. in diameter. In the one supplied to Scunthorpe, roller bearings have been used throughout to reduce the necessity for lubrication maintenance. The locomotive follows the conventional rigid-frame design composed mainly of steel sections, and most of the weight is in the under-frame. The Diesel generator sets are mounted on resilient supports to reduce the shock during buffing operations. The fabricated steel stretchers form a continuous deck between the frames on which the generator sets are mounted, so as to avoid oil or water from the power unit dropping on to the traction motors. Bearer plates on the stretchers carry the three-point mounting supports for the power units; a transverse fabricated bridge straddles the frame carrying the air reservoirs and other brake equipment, and forms the platform on which the central cab is mounted. Access to the cab is by steps behind the buffer beams leading to two diagonally opposite doors. One of the great claims for this locomotive is good visibility for close operations.

The drive to the wheels is by two nose-suspended motors, one of which is shown in Fig. 2, mounted one on each of the outer axles; these drive through a gear ratio of 22·85 to 1. The controls are mounted on a central desk allowing the driver to move all round the cab without inconvenience. A full set of controls consisting of throttle, reverser and brake is duplicated at both ends of the desk so that the driver can direct the locomotive from either side and facing either direction. The sanding pedals are at each end of the cabinet. Throttle and reverser are interlocked mechanically to prevent the reverser being changed while the throttle is open, or the throttle being opened when the reverser is not in one or other position. A Servis operation recorder is mounted on one bulkhead.

The fundamental traction circuit consists of a reverser and a contactor connecting each generator and traction motor. The contactor is operated from a 24 volt battery, and the reverser is mechanically operated by a link from the driver's reverse lever. The locomotive power is varied by altering the engine speed so that once the traction contactor has closed, the movement of the controller lever serves only to increase the speed of the Diesel engines by altering the setting of the governors. The engine can be started by motoring the generator from the main battery, which for this purpose is connected in series to give 48 volts. The maximum output of the Diesel engine is determined by a fixed stop on the fuel-injection pump control rack. When it is desired to run on reduced power one of the Diesel engines can be shut down. Orthodox buffing gear is fitted as standard equipment but can be varied to suit customers' requirements. The overall length of the 400 h.p. locomotive is 29 ft.; the 200 h.p. version is identical in operation but has only one engine generator set.

Very high performance has been obtained with this locomotive at Scunthorpe, but this is necessary as even with a seventeen-year-old steam locomotive an availability of 74 per cent. was usual. The Diesel has been working for continuous periods of nine days, 24 hours a day, at the end of which time it has been taken to the shops for a check-over. This has taken only seven hours as against the 24 required for a steam engine. Tractive effort curves are given in Fig. 3.

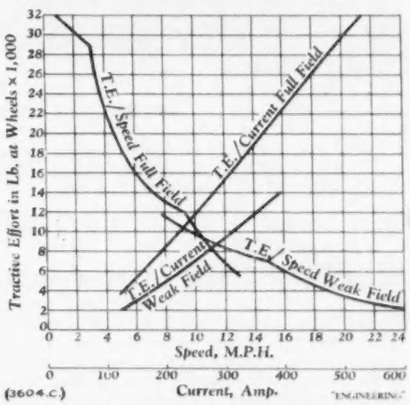

Fig. 3 Tractive effort curves for the 400 h.p. locomotive

In the demonstration the locomotive was shown on routine work such as bringing 376 tons of ore from the workings up slopes varying from 1 in 70 to 1 in 50; in the ingot stripping section shunting the ingot cars from the melting-shop to the stripping shed; and handling the slag ladles from the furnaces to the tip.

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TRANSFORMER COOLANT

In all power transformers a certain amount of heat is generated due to the resistance of the coils and the eddy currents in the core. This heat has to be removed, which is done sometimes by circulation of a coolant or by air cooling, in which case class-H insulation is used to allow a higher operating temperature and therefore a higher loading.

Monsanto Chemicals, Limited, London, S.W.1, have produced a coolant, Aroclor 1248, which is stable at temperatures of 160 deg. C. and over, compared to the maximum of 120 deg. C. possible with normal oil-cooled units. A constant breakdown value of 60 kV was obtained for this coolant, over a range from room temperature to 150 deg. C. Aroclor 1248 has a pour point of − 10 deg. C., and cavitation due to freezing does not occur above − 20 deg. C. It should be noted, however, that the silicone varnish bonding of some insulation tends to dissolve in the coolant at temperatures approaching 200 deg. C.

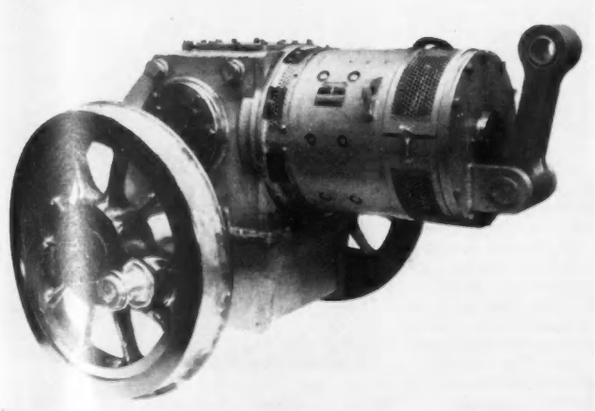

Fig. 2 One motor is mounted on each of the outer axles and drives through a reduction of 22·85 to 1.

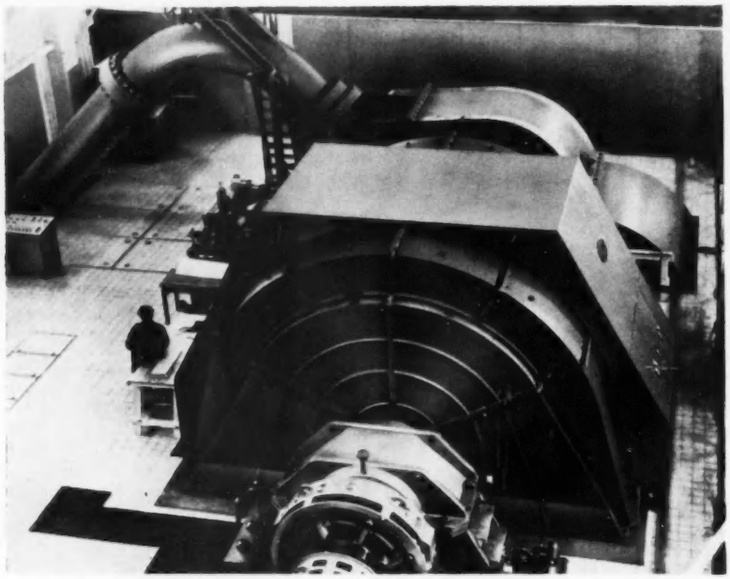

Fig. 1 62·5 MVA, 12·3 kV General Electric alternator and Escher Wyss Pelton wheel at Aura power station, Norway.

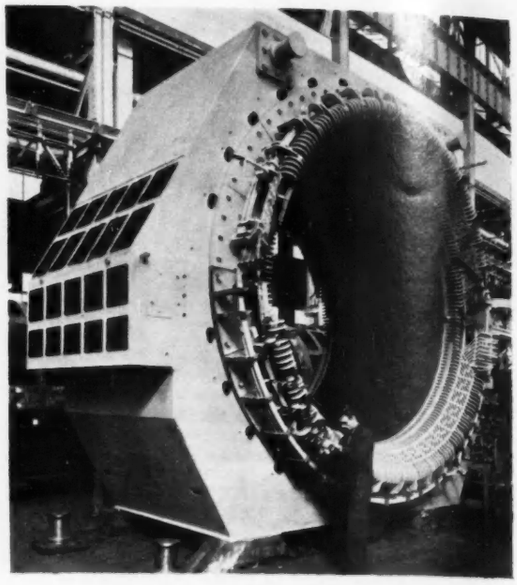

Fig. 2 Alternator stator being wound.

62·5 MVA PELTON WHEEL ALTERNATOR

MODERN UNIT FOR NORWEGIAN ALUMINIUM FACTORY

A new factory for the production of aluminium at Sunndalsora in Norway is supplied from a neighbouring underground power station at Aura through 12 parallel three-phase cables and overhead lines which are connected to busbars in the works. From these busbars eight parallel circuits feed groups of rectifiers through auto-transformers and rectifier transformers, the complete installation being arranged for 24 phase operation.

The generating plant in the power station consists of an Escher Wyss Pelton wheel, which runs at 428·6 r.p.m., and is coupled to a 62·5 MVA alternator, manufactured by the General Electric Company, Limited, Kingsway, London, W.C.2. This set, which is illustrated in Fig. 1, supplies three-phase current at 12·3 kV and a power factor from 0·85 to 0·95. It is therefore one of the largest horizontal shaft hydro-electric sets on the Continent, the alternator alone weighing over 310 tons, of which the rotor accounts for 170 tons.

MECHANICAL CONSTRUCTION

The mechanical construction of the alternator was influenced by transport difficulties, which limited the weight of any individual part to 60 tons. The stator is in two halves and, in view of the restricted headroom in the power station, a special lifting beam was designed for use during erection on site. The rotor body is constructed so that it can be split in half and the stub shafts removed. Each of these parts as well as the poles was separately crated for shipment and the complete machine was re-erected on site.

The alternator, main exciter and permanent magnet governor generator are directly coupled. The main exciter field is normally controlled by an automatic voltage regulator. When the set is running on hand control this field is energised from the station batteries.

STATOR DESIGN

The stator frame is a fabricated structure. It was built in two halves, which are fastened together by fitted bolts. The core is constructed on standard lines, segmental stampings being secured by dovetailed keys, which are bolted to longitudinal ribs within the frame. The stampings are of non-ageing silicon steel, the eddy current and hysteresis losses of which are small; and were accurately cut and slotted on precision presses. Any burrs produced by this operation were removed by grinding after which the stampings were annealed and finally coated on one side with insulating material. Additional insulation was introduced at intervals between packets of laminations during assembly, while ventilating ducts were incorporated to divide the core into sections and thus to ensure effective cooling. The core is stepped at the ends to reduce fringing and consequent losses.

WINDING ARRANGEMENTS

As shown in Fig. 2, the stator winding is of the two-layer diamond, or basket, type. Each slot accommodates two coil sides, which are joined at the evolutes by brazing. Each half coil consists of a number of sub-conductors, which are insulated from each other by micanite and are suitably transposed to reduce eddy currents.

The slot portion of the coil is covered with Micafolium bonded with a bitumastic varnish which was consolidated in a heated press into a hard seamless tube free from voids. A conducting sheath is moulded on to the outside of this tube and being in direct contact with the stampings prevents the formation of corona within the slots.

The end windings are insulated by glass-baked mica tape which is bonded with a bitumastic varnish each layer being hot-ironed into position. A specially constructed joint between the slot insulation and the taping of the end winding ensures that there is no loss of electrical strength at this point. The end windings are bound to insulated support rings; and blocks of insulated material are fitted between adjacent coils in such a way that all the coils are effectively supported against short-circuit stresses. The complete winding was treated with several coats of moisture-resisting synthetic resin varnish.

Remote indication of the temperatures of the core and windings is effected by six thermocouples which are embedded in the stator.

ROTOR COIL BUILDING

The rotor is designed for a safe overspeed of 780 r.p.m. The two halves of the body, into which the laminated poles are T-slotted, and the two stub shafts are secured by 14 through bolts. Each pole winding was fabricated from flat copper strip using brazed and ground dovetailed joints as shown in Fig. 3. The makers claim that this method of coil building has the advantage that the number of turns can be made wider, so providing a series of fins on the finished winding and thus affording additional cooling surface. Moreover, the pole can be made without any appreciable radius at the corners, thus reducing the overall length of the mean turn.

The inter-turn insulation is of resin-impregnated asbestos paper the completed coil being consolidated under heat and pressure to obviate any subsequent movement of the individual turns. The finished coil is insulated from the pole by asbestos boards and washers, which are bonded by synthetic resin.

The squirrel cage damping winding is formed

Fig. 3 Detail of dovetail joints of the pole windings for the Aura alternator.

of copper rods in the pole face, which are connected by Duralumin rings.

The alternator is cooled on the closed circuit system, cool air being drawn in by two centrifugal fans one at each end of the rotor and discharged at the bottom of the stator casing. The warm air is cooled in a cooler having a capacity of 96,000 cub. ft. of air per minute, which is capable of dissipating 1,200 kW.

The rotor is carried in two journal bearings which are force-lubricated, the flow being so arranged that the oil also acts as a cooling medium. The rotor can be floated on a high pressure film to facilitate starting.

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DIRECTION INDICATORS

London Transport has been experimenting since 1949 with semaphore type indicators for buses and coaches, but after trials of over 200 sets of equipment had been carried out it was decided that the moving-arm indicator had not reached a sufficient degree of reliability and robustness for the purpose. With the introduction into this country of flashing indicators further trials

London Transport are experimenting with flashing direction indicators, mounted (on the double-decker) above the driver's mirrors.

were started, and the first practical application of the new design was on the prototype "R.M. Roadmaster," now running in experimental passenger service. The trials have been extended and 87 "RT" double-deck buses, and 38 "RF" single-deck vehicles (including Green Line coaches) are to be equipped. The indicators take the form of a single fitted unit at each side of the vehicle showing an amber light to the front and rear, combined with a repeating signal at the rear. The illustration shows them fitted to a double-deck bus above the driver's mirrors.

The front unit is housed in a casing about 6 in. wide by 4¾ in. high, tapered from top to bottom to give a slight slope down to normal eye-level. The indicating area is in the form of a blunt arrow-head, of slightly more than the required minimum of 12 sq. in. On double-deck buses it will be attached to the sweep-in at the front of the driver's canopy, just above the driving mirror. On single-deck vehicles it will be mounted on the cant rail above the driving mirror. The casing is pivoted on a vertical axis on the two hollow legs of a U-bracket attached to the vehicle, the lower leg taking the electric leads and the upper containing a spring-loaded plunger catch. The unit can swing a short distance forwards or backwards against the spring without causing maladjustment; if forced back against it, the unit will click over to the right-angle position parallel to the vehicle side. The latter position will be used for close parking or during the mechanical washing process. Lenses are of plastic, and the 21 watt bulbs used, it is considered, will give the necessary marked contrast.

The repeating amber signal at the rear consists of a double-ended arrow, towards the offside of the vehicle. This arrow was included in the design of the post-war bus, and, as the fitting was provided before April, 1955, its use is permitted under the revised regulations. The new "RM" has a separate arrow on each side of the rear panel, as will any future vehicles, to conform to the regulations.

Two main types of flashing mechanism are being tried, a slugged relay giving a delay action, and a motor-driven type. Three makes of the former and one of the latter are included in the experiment. The flashing rate of 76 per minute has been selected as providing the most arresting signal. The driver's switch is of automatic delay type (12 to 15 seconds), and on double-deckers is housed in a pedestal towards the offside of the cab floor; on single-deck vehicles it will be fitted to a switchboard on the cab waist rail close to the driver's right hand. Both incorporate the required warning lamp wired in series with the indicators.

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ALUMINIUM-ALLOY COAL AND COKE CONVEYOR BUCKETS

An experiment on the use of an aluminium alloy for solid-fuel conveyor buckets was put in hand over two years ago, in February, 1954, at the Windsor Street Works of the West Midlands Gas Board, Birmingham. The buckets were fabricated by the New Conveyor Company, Limited, and the experiment is in the nature of a co-operative investigation between Mr. F. J. Bengough, who is the engineer and works manager at Windsor-street, and T.I. Aluminium Limited, which firm supplied the alloy.

One of the two aluminium-alloy buckets under test has been fitted to a continuous coke conveyor and the other to a coal conveyor; the alloy used was Timinium 223. This, we are informed, is equivalent to material NS5M, an aluminium-3 to 4 per cent. magnesium-1 per cent. manganese alloy, particulars of which are given on page 28 of B.S. 1470 : 1955. The other buckets are of the conventional steel type and consequently a good opportunity has been afforded for the comparison of the performance.

The coke conveyor is out of doors and it receives coke tipped from wagons and loads the material into three concrete storage hoppers. The buckets are fed from the wagons by a 12 ft. chute having a pitch of about 45 deg. This imposes a fairly severe impact on each bucket. The half-hundredweight or so of coke is emptied from the bucket by progressive tipping, controlled by a cam operating on the bucket-carrier frame. A further test occurs when the emptied bucket is tipped back to the normal position under its own weight. Its forward lip takes an impact against a box built into the frame and acting as a front stop. Whereas many of the steel buckets exhibit damage along the lip caused by this impact, the aluminium bucket is stated to show only a faint even line and no appreciable denting.

Moreover, the surface of the aluminium-alloy bucket indicates that the abrasive action of the coke, which is often moist, has had no significant effect upon it; on the other hand, layers of rust can be seen on the steel buckets and their effective life, it is stated, is less than three years. The accompanying illustration shows the clean surface of the Timinium-alloy bucket compared with the two rust-scaled steel buckets below it.

The frame attaching the bucket to the conveyor is of malleable iron and the two metals are insulated from each other by a zinc chromate coating which has proved adequate to prevent bi-metallic corrosion.

The coal conveyor into which the other

Coke-conveyor buckets at Windsor Street Gasworks, Birmingham. The two lower ones are of the conventional steel type and show evidence of corrosion. The uppermost bucket, made of aluminium alloy, is free from corrosion.

aluminium-alloy bucket is fitted is situated in the retort house. Although there is less airborne moisture than is the case with the coke conveyor, the coal is often wet on delivery, the impact loading is heavier and the dust very much thicker. It is noticeable that the combination of corrosion and impact causes holing in the sides of many of the steel buckets which then need patching. No sign of such an effect, however, is visible in the Timinium-alloy conveyor bucket.

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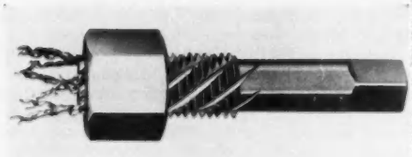
UNCONVENTIONAL SCREW TAP

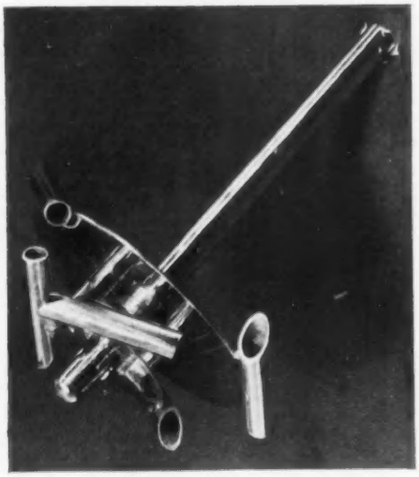
The "Unbreaka" screw tap, made by the Shearcut Tool Company, 7045 Darby-avenue, Reseda, California, U.S.A., possesses some unusual features. Its design is such that the chips are driven ahead of the tool, as shown in the accompanying illustration; consequently, it is claimed, tap breakage through chip interference is entirely eliminated. The left-hand flutes feed the coolant or cutting oil downwards to the cutting point, dissipating heat and washing



The "Unbreaka" tap.

away small particles of metal which tend to cause abrasion and shorten tap life.

Cutting torque is stated to be only about half that required for an orthodox tap; for example, an "Unbreaka" tap 1 in. in diameter by 8 threads per inch required 700 in.-lb. when tapping in a hole ⅞ in. in diameter in cold-rolled steel, while a standard tap required 1,350 in.-lb. The tap is designed to operate at two to four times normal tapping speed, that is, at drilling speeds or faster.



The conical tubes of the Impelator are set at angles to give strong counter currents which will aid in mixing.

MIXING SOLUTIONS

Counter Currents Combined with Shearing Action

A very large number of manufacturing processes involve the mixing of solutions of emulsions at some stage. Several mechanical devices are available for this purpose, and a newcomer to the field is the Impelator, made by Plenty and Son, Limited, Eagle Iron Works, Newbury, Berkshire. It is shown in the illustration above.

As may be seen it consists of a number of small conical tubes welded to discs which are then bolted to a distance piece fitted on the driving shaft. The latter is mounted vertically in the liquid to be mixed and may have more than one set of mixers fitted to it. The tubes are caused to rotate at a fairly high speed and the angle at which they are set causes the liquid to flow through them and impinge on the slower moving portions of the solution. The resulting flow lines give rapid changes in direction and very efficient mixing. The fact that half the number of tubes in each set is arranged to point upwards and the other half downwards adds to the turbulence caused.

The mixer is available in three standard types, the first being designed for laboratory use and having a $\frac{1}{4}$ in. stainless-steel shaft with stainless-steel Impelators on it. The unit is complete with a variable-speed motor mounted on a stand which is adjustable for height and angle. The industrial type has a $\frac{1}{2}$ in. diameter shaft and is intended for capacities up to 30 gals.; it is supplied with a driving motor and fixing brackets for vessels up to 18 in. in diameter.

The third type has seven sizes and is for large-capacity vessels ranging from 20 to 3,000 gallons; it is supplied with driving motor and fixing brackets. The material for those parts in contact with the product under treatment is normally stainless steel but this can be varied to suit customers' requirements, such alternatives as monel metal, phosphor bronze or metal coated with P.V.C. being available.

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CLEANING PLANT FOR MINE CARS

The illustration on the right shows a fully powered horizontal cleaner, which has been developed by Messrs. Humphrey's and Glasgow, Limited, Carlisle-place, London, S.W.1, for use with mine cars that have been employed for carrying stone from stone-headings. It is particularly recommended if the headings are very wet or if a great deal of water has been used for dust control, so that "concreting" occurs at the bottom of the cars.

The cleaner is chain-driven by a 5 h.p. 550 volt totally enclosed three-phase motor and consists essentially of four radial brushes made of pieces of waste wire haulage ropes which are mounted on two protruding jibs. These brushes are slightly off-radial on their revolving hubs so that they can plough into the dirt. Alternatively, picks can be provided for dealing with particularly obstinate material. The weight of the brushes and jibs is balanced by a control and drive box, which houses the motor, and the whole machine pivots on a horizontal shaft, at each end of which is a pinion and rack. These racks are bolted to a concrete base; while above and parallel to the main shaft is a second worm shaft of the same length which guides the lateral movement of the cleaner. The rotation of the pinions along the racks gives either forward or reverse motion.

JOYSTICK CONTROL

For operating purposes the cars are turned through 90 deg., as shown in the illustration, and the motion of the cleaner is switched on by one man who stands behind the control box in line with the benches, and adjusts the forward and lateral movement through friction clutches by a joystick. During cleaning he is protected from flying dirt by a vertical steel plate, which is placed between the driving position and the brushes. Canvas curtains can also be hung vertically at either side of the control box. The cleaner is supported by two legs under the control box, which are prevented from digging into the concrete base by means of a curved skid.

Two types of these horizontal cleaners are available, one of which, such as that illustrated, can be used for dealing with one car at a time, while the other can clean two cars coupled together in a tippler. Both types can be adapted for use with any design of mine car including the Granby.

Pedestal-mounted winch vertical cleaners for overhead mounting and larger units for cleaning railway wagons are also available.

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SLIDING-WEDGE ROOF BOLT

The sliding-wedge roof bolt shown in the accompanying illustration has been brought into use by the National Coal Board and is the joint design of Mr. Frederick Sidney and Mr. Keith Shaw of the East Midlands Division of the N.C.B.

The bolt has two main components, the rod A and the wedge B. The rod is of $\frac{3}{4}$ in. diameter mild steel and may be of any required length, though practice shows that 5 to 6 ft. is usual.

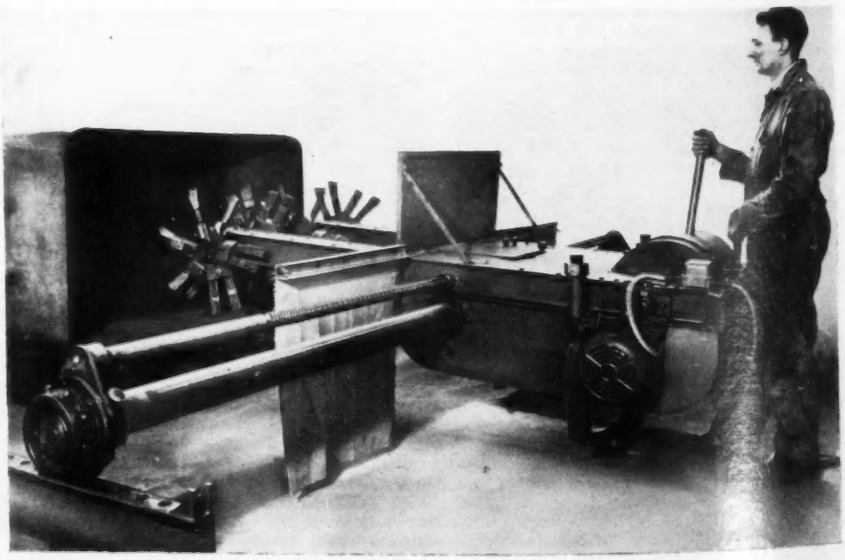
ANCHOR

The head of the rod is shaped as shown and, together with the wedge, forms the anchor, 6 to 9 in. long, which holds the bolt in position, the ledge C acting as temporary rest for the wedge while the bolt is being put into position. Good gripping contact with the side of the drill hole is obtained by the serrated side of the wedge which may be of either steel or malleable iron. A thin rubber or plastic retaining disc,

The roofs of tunnels through rock, particularly shales, may conveniently be secured by rock bolts of which the variant shown here has recently been introduced by the N.C.B.

larger in diameter than the bolt head and the drilled hole, and secured to the wedge by two studs E, holds the wedge in position initially.

The lower end of the rod is threaded to receive the bearing plate and retaining nut (not shown). In use the rod and wedge are forced into the hole drilled in the rock strata. The bearing plate is put into position and tightening of the retaining nut draws the rod down, forcing the wedge into the side of the hole until a firm anchorage has been obtained. Quick and effective fixing of the bolt is hastened by the smooth faces of the bolt head, eased with a suitable lubricant, so that the rod is easily pulled down while the wedge remains in position.



Electrically driven plant for cleaning mine cars, showing radial brushe

In Parliament

HIGH ENERGY PHYSICS

Attention was drawn in the House of Commons last week to recent Russian developments in connection with atomic energy problems. Mr. C. L. Hale (Labour) asked Mr. R. A. Butler, the Lord Privy Seal, whether he was aware that British physicists attending the official conference on high-energy nuclear physics in Moscow a short time ago were shown a high-energy synchrocyclotron giving beams of protons of 680 MeV, as well as a new proton synchroton containing 36,000 tons of steel, and that they had been informed that an even larger synchroton was under construction.

Mr. Butler said that he was aware of the large facilities which were being created by the Soviet Union for fundamental nuclear research. So far as Great Britain was concerned, the Government, as a member of the European Council for Nuclear Research, were collaborating in the construction of a 600 MeV synchrocyclotron, and of a 25,000 MeV proton synchroton, of the most advanced design at present known, at the High Energy Physics Laboratory which was being built up in Geneva.

TRAINEE AIRCRAFT FITTERS

The Minister of Labour and National Service was asked by Captain H. B. Kerby (Conservative) when the practice commenced of sending trainees from the Park Royal Government Training Centre to the Air Ministry for employment as aircraft fitters. In reply, Mr. Robert Carr, the Parliamentary Secretary to the Ministry, said that no records survived of when men trained at the Centre before the last war were first sent to the Air Ministry for employment in that capacity. It was within the recollection of some of the officers of the Ministry of Labour, however, that a few trainees went into the employment of the Air Ministry before the large-scale training scheme for Air Ministry employment began early in 1939.

Later, Captain Kerby inquired as to the status accorded by the Air Ministry to employees who had entered that Department in 1938 and had been employed as skilled aircraft fitters at the Flying Training School at Netheravon, Wiltshire, but whose only other industrial background had been a vocational training course at the Park Royal Centre. Were they, he asked, regarded as metal-working craftsmen, or as having some other status, and what was the present status of such of these employees as might still be in the service of the Department? The Secretary of State for Air, Mr. Nigel Birch, said that, in both cases, such employees would be regarded as dilutees. He added that there had been no agreement between the Amalgamated Engineering Union and his Ministry, as to the minimum industrial connection of employees subsequent to October 21, 1939, which would entitle them to be recognised as skilled metal-working craftsmen.

F.I.D.O. FOR LONDON AIRPORT?

In reply to Mr. S. Knox Cunningham (Ulster Unionist), who brought up the problem of maintaining visibility at London Airport, Mr. John Profumo, the Joint Parliamentary Secretary to the Ministry of Transport and Civil Aviation, said that the lowest declared visibility for operations at the airport was 150 yards.

Visibility fell below that figure for more than one hour on 43 days in 1953, on 12 days in 1954, and on 18 days in 1955. The aggregate number of hours in each year when this happened was 200 hours in 1953, 60 hours in 1954, and 117 hours in 1955. As to the advantages which would accrue to air transport if the airport were to become one of those which could be used in all stages of visibility, Mr. Profumo said that it had to be borne in mind that there were diversionary airports to which companies could operate in the case of fog. The device known as F.I.D.O. (for "Fog Intensive, Dispersal of") would clear only fog, and not low cloud, heavy rain or snow; conditions which were frequently responsible for poor visibility. The cost of installing a complete F.I.D.O. system at the airport was last estimated, in 1954, at £335,000 and the annual standing charges at £74,000; figures which should now be increased by about 15 per cent.

Annual fuel costs depended, of course, on how often the system was used in any year, but, assuming 1,000 burns spread between take-offs and landings, the annual fuel cost, according to estimates at the time, was £154,000, and would now amount to about £160,000. These figures were based on apparatus burning heavy oil. The Government were anxious to assess the cost of clearing various degrees of fog, as only then would they be able to measure realistically the extent to which it would be economic to operate the system at the airport. Tests in the United States had proved unsuccessful.

The Government had not ruled out the adoption of F.I.D.O. and joint experiments were to be carried out at a Royal Air Force station to enable a final and realistic assessment to be made. In the present stage of F.I.D.O. experiments, it would not be right for the House to consider that the system could be regarded as wholly safe. An aeroplane not only had to be brought down, but it had to be brought safely to a halt, and, if only a narrow area had been cleared, there might be difficulties should the aircraft go off the runway into fog.

TECHNICAL EDUCATION PROBLEMS

Mr. Malcolm MacPherson (Labour) raised a number of matters relating to technical education, of which several appertained to Scotland. He was informed by Sir David Eccles, the Minister of Education, that, where teachers of technical subjects were recruited from industry, they were, in most cases, over 25 years old at the time of their transfer. The number of men who had changed their occupations in this way during the last three years was, however, not readily available.

The Secretary of State for Scotland, Mr. James Stuart, stated that the projected increase of 15,000 in the number of day-release students in Scotland, envisaged in the White Paper on *Technical Education* (Cmd. 9703), was no more than a first step designed to bring the number of students in Scotland up to a figure equivalent to that in England and Wales. The White Paper made it clear that further increases would be necessary to keep Scotland in step. If the total of 355,000 day-release students in England and Wales were to be doubled, an increase of 45,000 would be necessary in Scotland to give that country the equivalent number on a population basis. As in the past, Scottish education authorities were being given every encouragement to provide more and better facilities. In that connection, Mr. Stuart said, he had already approached such agencies as the Regional Advisory Councils for Technical Education, the Scottish Council (Development and Industry), and the Scottish Board for Industry, to obtain their co-operation in persuading both sides of industry to make the maximum use of the facilities provided.

Exhaust Gases from Diesel Engines

Problems arising from the discharge of gases by Diesel engines were raised by Mr. Ronald S. Russell (Conservative). He inquired about the composition of these gases and was informed by Mr. J. R. Bevins, the Parliamentary Secretary to the Ministry of Works, acting on behalf of the Lord President of the Council, that, where Diesel engines were properly maintained and operated, the exhaust fumes contained a small amount of solid carbonaceous matter and the following gaseous constituents, listed in descending order of concentration: nitrogen, carbon dioxide, oxygen, carbon monoxide, oxides of nitrogen, hydrogen, hydrocarbons, oxides of sulphur and aldehydes. In cases where engines were not properly maintained and operated, the concentrations of carbon monoxide, oxides of nitrogen, hydrogen and hydrocarbons were higher and, in addition, there might be sufficient solid carbonaceous matter to produce blue-grey or brown smoke. In extreme cases, a dense black smoke might be discharged. The emission of visible smoke from a Diesel engine was due either to the engine being in poor condition, or to over-loading, or to the maladjustment of the fuel control by the driver.

Smoke Arrestor Demonstration

A plea for the use of smoke arrestors in the campaign for clean air was made by Mr. S. T. Swingler (Labour). He asked the Minister of Housing and Local Government about the experiment with an arrestor at Chesterton, Newcastle-under-Lyme, on May 9 and inquired to what extent the Ministry proposed to promote the use of these devices. In reply, Mr. Duncan Sandys said that the district alkali inspector for the area had attended a most interesting demonstration of equipment of this type. Nevertheless, much fuller information and more prolonged experiments were needed before any reliable opinion could be given as to the practicability and effectiveness of such devices in regular use under normal conditions.

Water Supplies

Mr. Sandys said that a great deal had been accomplished in recent years to develop water supplies, such as by increasing storage capacities, improving purification arrangements and extending piped supplies in rural areas. Much information regarding these improvements, he told Mr. J. Grimond (Liberal), would be found in the latest report of the Ministry of Housing and Local Government. Recently, the Central Advisory Water Committee for England and Wales had been reconstituted and at his suggestion, Mr. Sandys said, the Committee had commenced an investigation into the growing demands for water for all purposes and into the most practical means of meeting these requirements.

Radio Strontium in the Atmosphere

In reply to Mr. Roy Mason (Labour), who asked about a monitoring system for the United Kingdom to check the increasing fall of radio strontium following atom and hydrogen bomb tests, Mr. R. A. Butler, the Lord Privy Seal, said that such a system was already in operation. The amount of radio strontium reaching the ground in the United Kingdom was monitored by the regular analysis of rainwater samples. The radio strontium still to fall was monitored through the analysis of dust samples collected by aircraft.

University Science Courses

The Financial Secretary to the Treasury, Mr. Henry Brooke, told Mr. Edward Evans (Labour) that the increasing demand for admission to science courses at universities was causing congestion in some institutions. Improved and enlarged laboratories had been provided on a considerable scale in recent years and others were under construction. In addition, plans for substantial future developments were being considered.

Deferments for Engineering Graduates

Mr. Iain Macleod, the Minister of Labour and National Service, told the House that deferment from national service was not granted to any category of university graduates as such, but that deferments were conceded to certain individual science and engineering graduates who were engaged on work of particular national importance. In answer to Mr. F. T. Willey (Labour), Mr. Macleod said that he had received no representations as to the effect of deferments of this kind on the recruitment of students to universities and technical colleges. The number of such deferments during the present year was expected to reach a level of about 1,400. If the number of deferments were to be shown in graph form, the line would be seen to have been climbing very steeply indeed over the last two years. Mr. Willey asked the Minister to see what more could be done to secure that these particular scientists could go where they were most needed.

THE HUMAN ELEMENT

The shortcomings and advantages of co-partnership—Current labour returns—Engineers in short supply—Demands for shorter hours—Union approach to office work—Union leader's prescription.

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Survey of Co-Partnership Schemes

The way of incentive schemes of all kinds is hard. They are rarely an automatic success and need to be constantly worked upon both by management and labour to promote an adequate return, as has been brought out recently by a survey of co-partnership schemes in 1954 by the Ministry of Labour. This survey, the first of its kind since 1938, took in 1,800 concerns. The results showed that there were 421 schemes in operation covering 389,000 workers; in addition there were found to be 130 companies with some 133,000 operatives on some variant of a co-partnership scheme.

A number of interesting facts came out of the survey, such as the comparatively large number of schemes now being operated in the engineering industry. The average addition to earnings under the schemes was 5·9 per cent. But the most significant fact of all, perhaps, was the high mortality rate among such arrangements. Of all schemes in existence in 1954, only 104 went back to the inter-war years. The main reasons for lack of continuity seem to have been transfer of business, diminution of profits and apathy among employees.

A recent survey of incentive schemes at the I.C.I. explosives factory at Ardeer has shown how important it is to keep working on incentive arrangements. Out of 200 disputes about half have been caused by arguments about incentive conditions and payments. In spite of this, labour-management relations are considered to be good. The fact is that these disputes bring troubles to the surface and enable them to be dealt with. A safety valve is thus provided and both management and labour never make the critical mistake of thinking that the other side's point of view can be taken for granted.

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Fewer Vacancies

Despite a decline in the number of vacancies registered with the Ministry of Labour (they fell by 10,000 in April) the general employment situation remains good. The number of people at work is rising, as would be expected in the spring of the year, and the number of unemployed increased only fractionally in May. The official figures in fact tell a rather more optimistic story than current general impressions.

There are several reasons why this discrepancy should exit at the moment. It is known that some industries are shedding part-time women workers. The cotton textile industry for example continues to lose labour. This kind of change in the labour market is difficult to record on official returns for many women do not bother to register changes in certain areas. Another feature is that companies can allow their normal wastage to run down their total force by the simple expedient of not replacing workers. Other concerns can reduce overtime while others again resort to under-employment as a means of keeping key groups of operatives intact. These added together can have a significant effect on the state of the labour market without making their full impact felt on the Ministry of Labour returns.

So far as the most recent figures go, however, they show that the brunt of the labour shedding is being done by the industries concerned with consumer goods. This is in itself a useful antidote to fears of depression in the capital goods industries when, as has recently happened, there is a series of announcements, especially from the Midlands, of short-time work and dismissal.

★ ★ ★

Lack of Civil Engineers

A warning of a chronic shortage of civil engineers was given recently by Mr. W. K. Wallace, President of the Institution of Civil Engineers. He pointed out that there is over £200 million worth of civil engineering work being done abroad at present, involving the shipment of large quantities of equipment from this country. In consequence, the demand for civil engineers is greater than it has ever been before. There were, he said, signs of increasing numbers of men wishing to qualify for corporate membership of the Institution but demand could not catch up with supply for some time.

Once more the fact is underlined that engineering is faced with an acute shortage of trained manpower which is likely to be much more serious over the next few years than other kinds of shortage, for it cannot be remedied within the compass of months or even a few years. Men are thin on the ground. It is all the more necessary to use them to best advantage. In this matter, overseas contracting is at the same time one of the biggest problems and one of the main causes of its intractability.

In the light of the shortage of engineers, it is interesting to note an experiment that has been initiated at a Nottingham grammar school. In co-operation with the Institution of Mechanical Engineers the school—High Pavement—has for the past two years had six of its sixth-formers working towards an Ordinary National Certificate in Mechanical Engineering. The boys have spent half a day a week at the Nottingham and District Technical College and have put in vacation time as apprentices in local industry.

★ ★ ★

The 40-Hour Week

The Confederation of Shipbuilding and Engineering Unions' executive announced, after the York meeting on the redundancy problem at Standard's (see Plain Words in this issue), that a claim for a 40-hour week would be submitted to the employers at a meeting on June 28. This is well in line with the trade union feeling in the engineering industry and a pointer to the stand likely to be taken at the Confederation's annual conference in August. Less overtime, a shorter working week and longer holidays were demands voiced quite loudly at the last annual conference, at the peak of the boom and before any sign of redundancy had appeared anywhere. The introduction of automatic controls in factories which have so far employed thousands of highly paid operatives on mass-production lines will give a considerably added impetus to these demands.

The engineering employers' recent decision to reject out of hand any further wage demand is unlikely to deter the unions from putting in new claims in August. But there is a growing realisation in trade union circles that excessive wages bills may threaten full employment. Whether or not a more moderate attitude can be "sold" to the rank and file is another matter. There is always the argument that redundancy in motor vehicles and consumer durable goods had been brought about by the credit squeeze, and is therefore part and parcel of a government policy to reduce the bargaining power of organised labour by creating pockets of unemployment. Few leaders would dare to come out in opposition to this feeling, however strongly they may feel that the well-being of their men is being threatened by their own unyielding attitudes.

★ ★ ★

A T.U.C. Report on Automation

An investigation of the problems which arise when the computer takes over in the office has been carried out by the T.U.C. Non-Manual Workers' Advisory Council. Their report, published last week, is a most [illegible] level-headed document remarkably free [illegible] doctrinaire thinking. It deals with the questions of redundancy, wages and earnings and resettlement pay, and analyses the likely impact of automation on office work. There are about one million office workers affiliated to the T.U.C., and the report's main conclusions will therefore be of considerable interest. The dominant impression given by the report is that there is to be no opposition to the introduction of automatic methods. The starting point could well be the resolution which is to be put to the annual conference of the National Union of General and Municipal Workers held at Llandudno this week: "that in automation lies the possibility of better living standards and greater leisure."

The report points out that automation in offices may have a sharper impact than in the factory and states that "ideally, for unions, automation would be introduced not too fast and not too slow—social and economic gains being weighed against industrial and commercial changes and adjustments." It should be no excuse for employers to cut the rate by simplifying the work. The union feeling is that workers have a right to share the gains resulting from higher productivity. But there would be little sense, or equity, in allowing wage rates in those offices which are the first to introduce automatic techniques to get out of line with the rest, or to reduce working hours disproportionately. The best approach, at any rate in the early years, would be to reduce prices, thus allowing the benefits of the new methods to be spread evenly throughout the country and to exports.

Resettlement was carefully considered. Basically the T.U.C. advocate that automation problems should be "largely the responsibility of the unions and employers in each industry, to be discussed and negotiated through the appropriate industrial relations machinery." No Government intervention is asked for. Compensatory payments to redundant workers are approved, to enable them to look for another job (possibly in another area) without hardship. Re-training facilities, especially for the older workers, are considered an essential part of any machinery set up to tackle the problem of resettlement: "technological innovation puts a premium on flexibility and mobility."

★ ★ ★

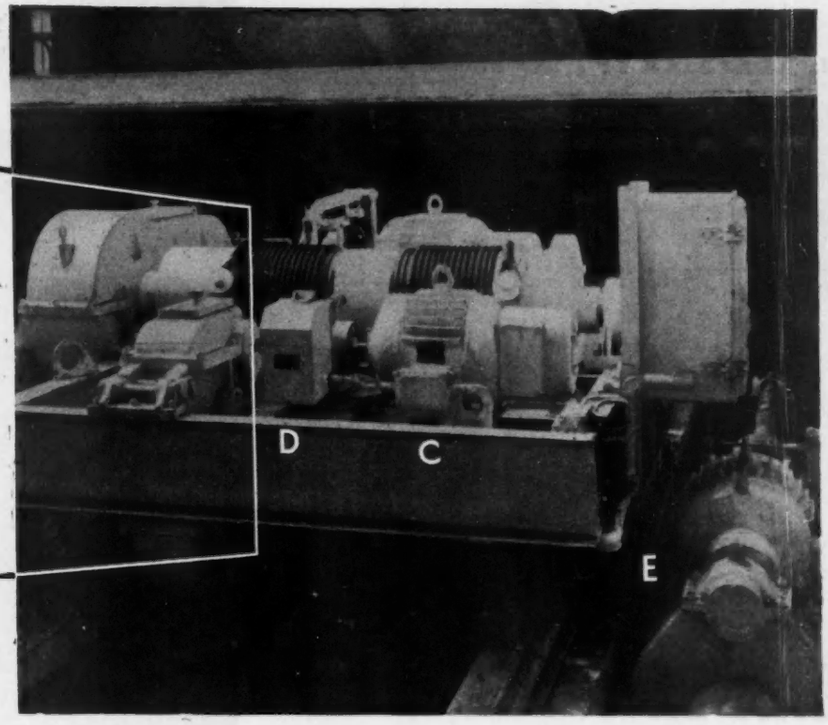
Production Wanted—Not Talk

Blunt works were spoken last week-end by Mr. J. H. Williams in his presidential address to the Association of Supervisory Staff, Executives and Technicians. If both sides of industry do not get on with producing goods and concentrate on doing so efficiently instead of arguing about the distribution "of the little bit of surplus," they will end up "like dogs fighting over a bone with no meat on it."

Mr. Williams' plea for a better spirit in industry is certainly a timely one, but his suggestions on how this should be achieved will not meet with everyone's approval. In his view the Government should take a more positive part in stabilising the present very fluid and dangerous situation. Prices must be held down, and workers convinced that equal restraint is being exercised by management and shareholders. He advocated strict control of profits—"including hidden profits and 'fake' expenses"—and also a national wages structure. If these things were done, hand in hand with measures to increase production, Mr. Williams saw no reason why industry could not offer both security and a higher standard of living to every worker.

There is sense in this kind of talk, particularly from a union man, but there is also danger in it. Neither unions nor industry are likely to want control of wages—implied in a national wages structure—or control of profits. Lurking in the background of any such proposals are further levelling, further deadening and throttling of enterprise. Enterprise is rarely fair, but often dynamic. At such a price, do we want fairness?

ON TOP OF THE JOB



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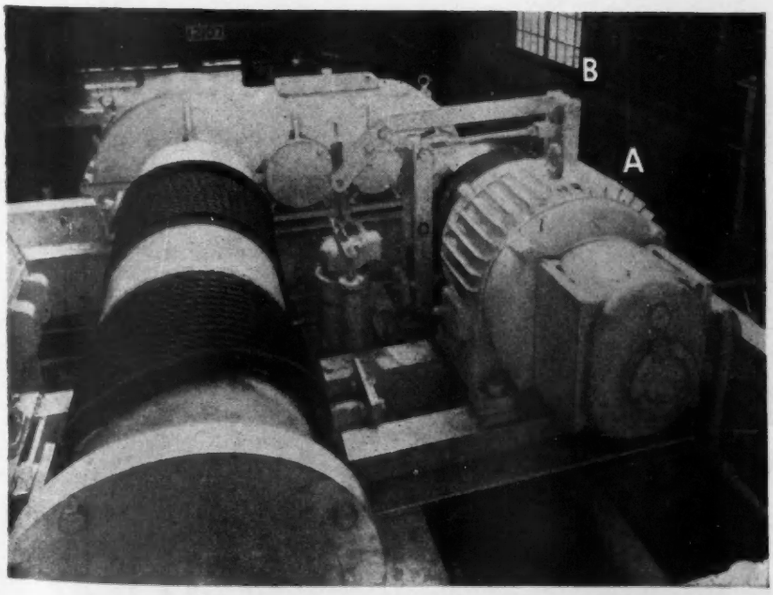

In the illustration (left) A is the 18-h.p. 720 r.p.m. hoist motor fitted with Stacreep thrustor control B. The long-travel drive, motor E, is shown at the top of page. The 3 h.p. cross traverse motor is seen at C and the 6-inch Perigrip brake at D.

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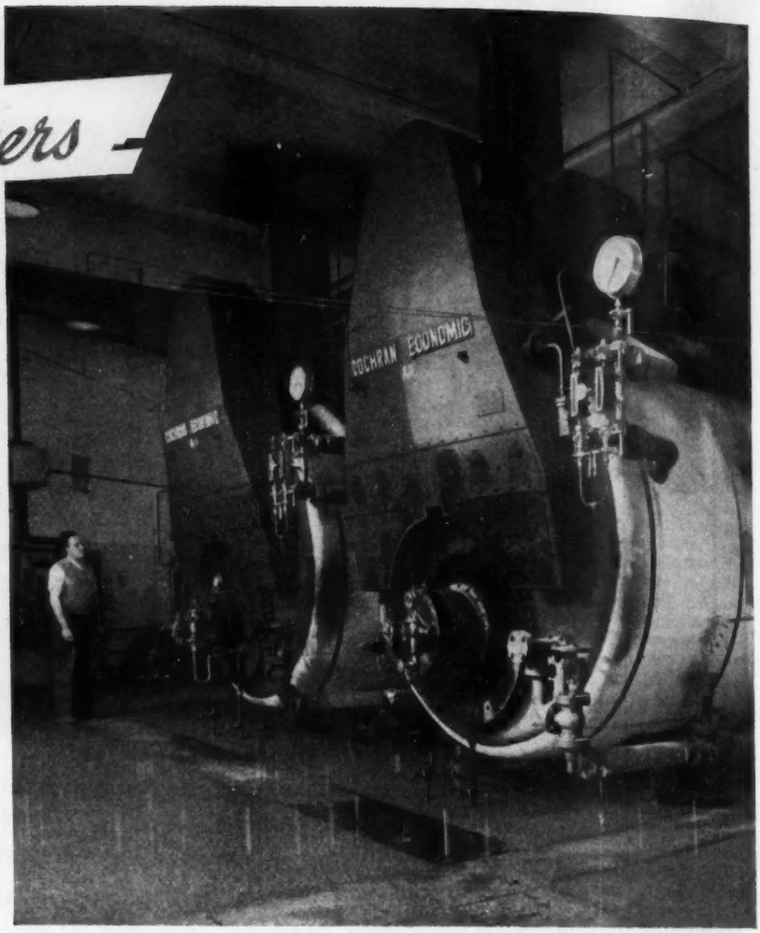

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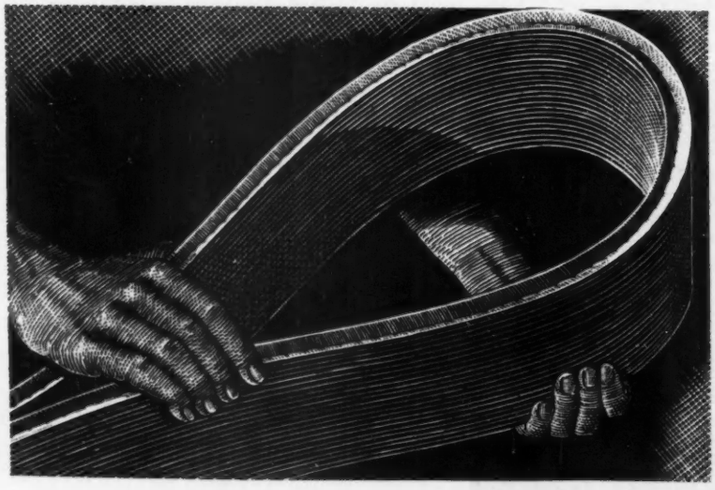

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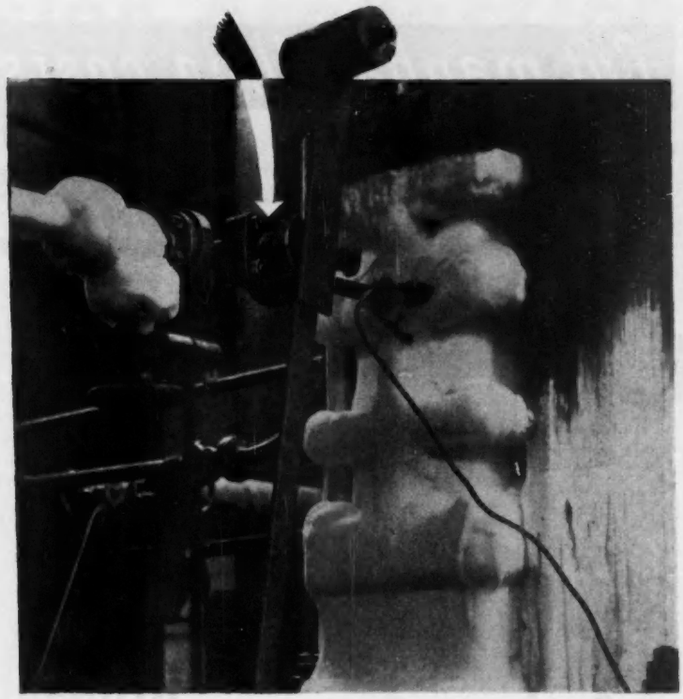

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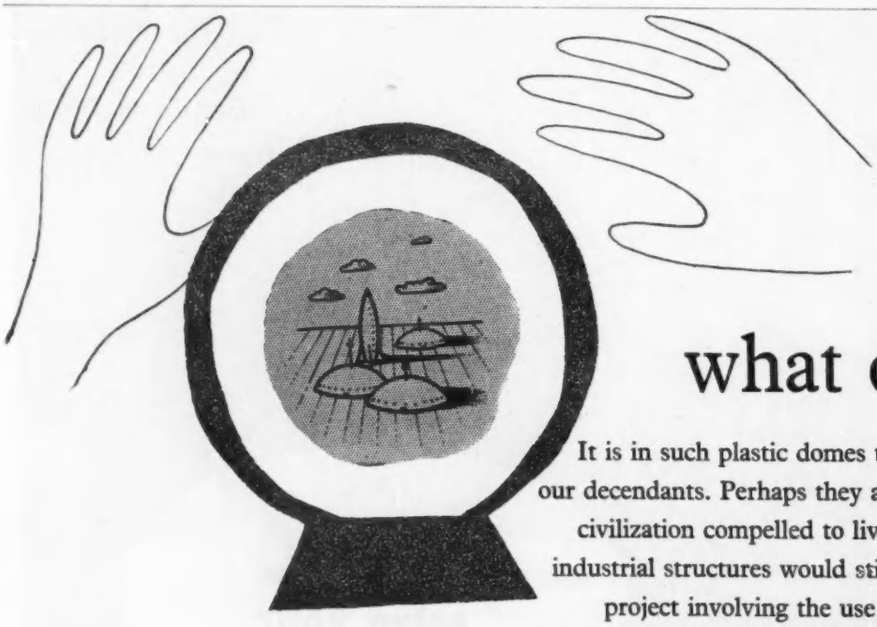

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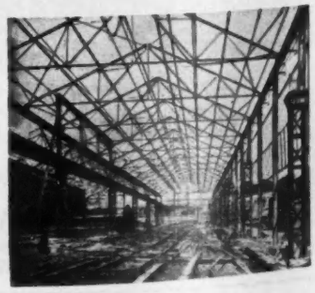

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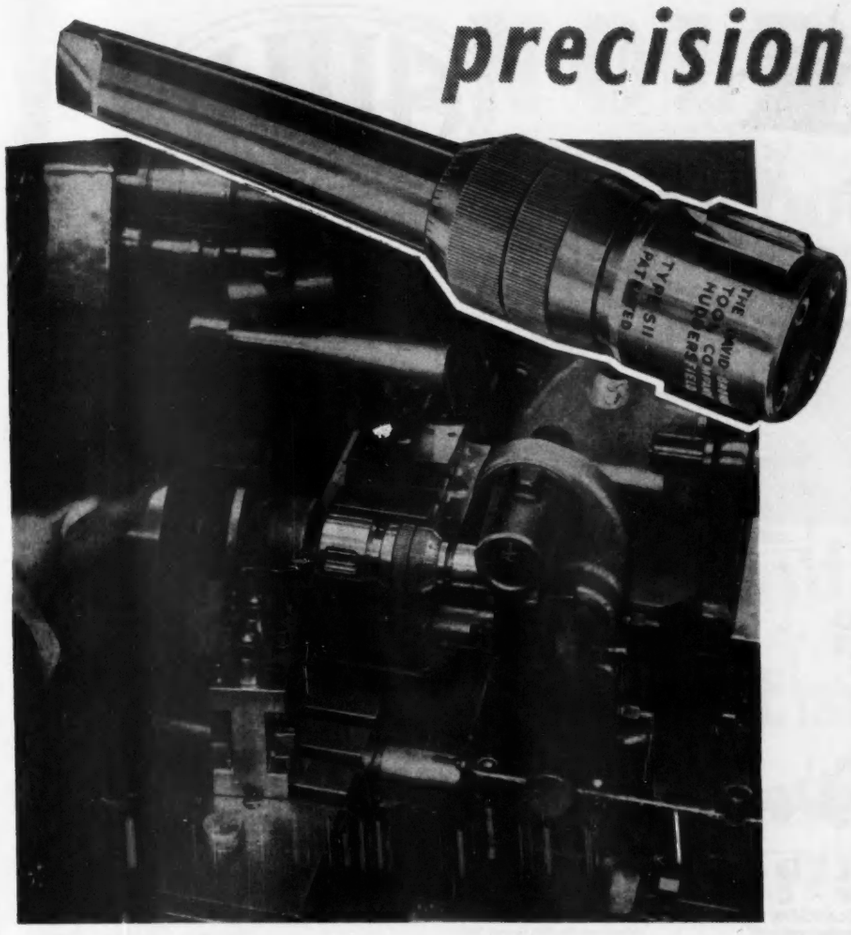

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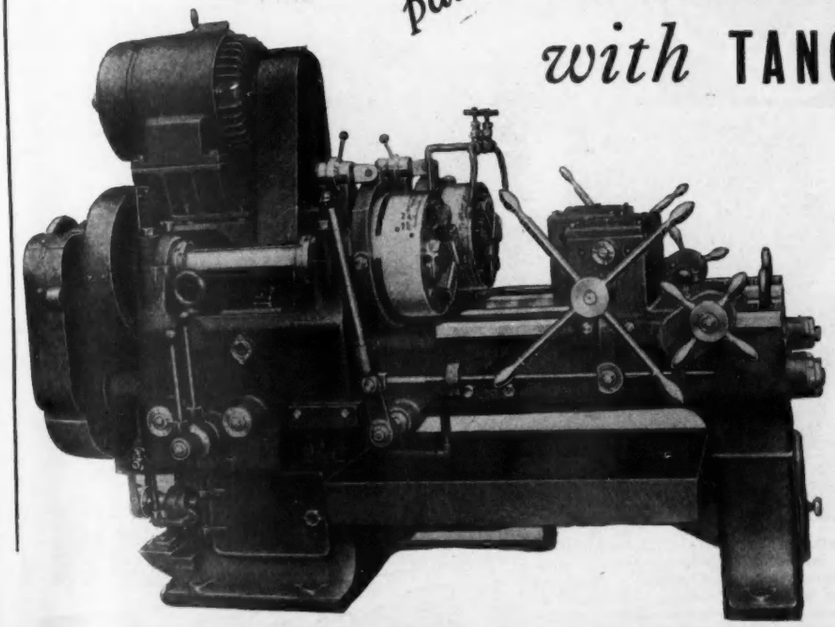

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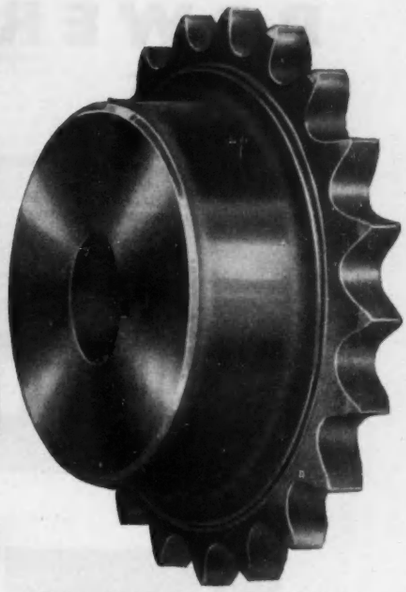

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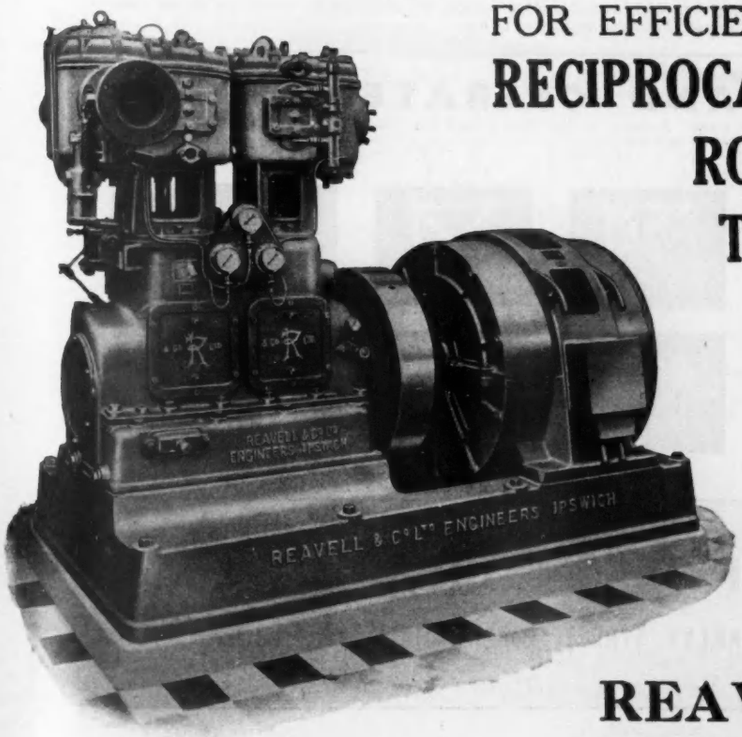

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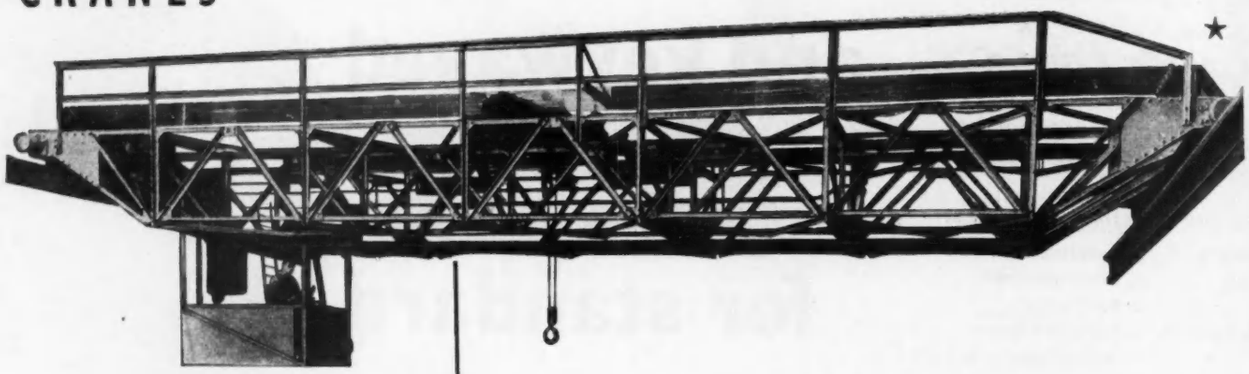

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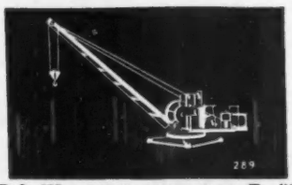

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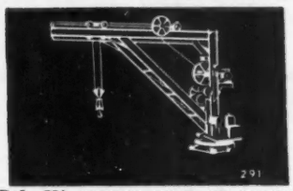

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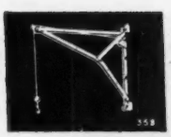

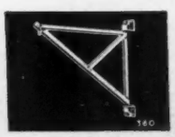

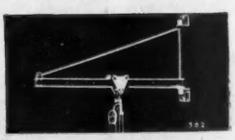

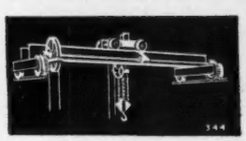

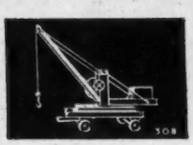

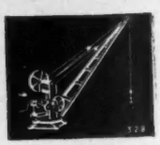

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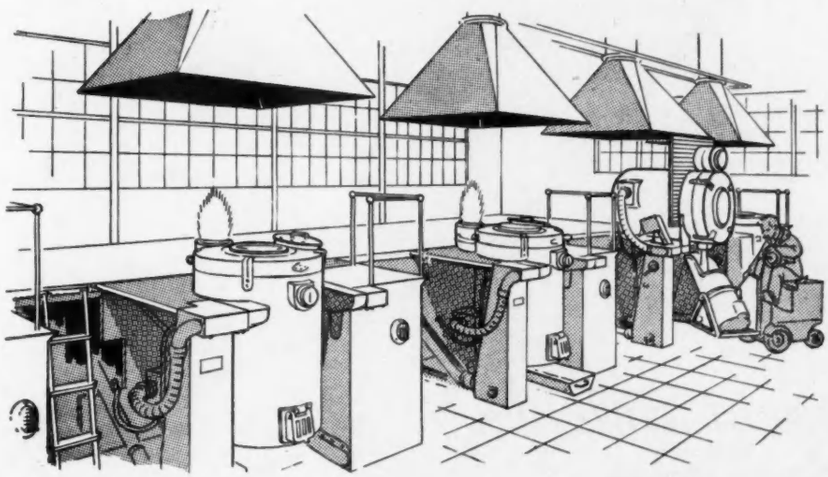
Ref. 328 WHARF CRANE with slewing and luffing gear. Supplied in a range of sizes to lift from 10 cwt. to 10 tons.

GIBBINS
SAVES LABOUR LIFTING

RICHARD C. GIBBINS & CO. LTD

BERKLEY STREET, BIRMINGHAM. Tel: MIDLAND 6183/4

The span of a century has seen the development of metal melting from the early slow, manually controlled and operated process to the exact metallurgical science of present-day crucible melting. In this period also The Morgan Crucible Company has grown to a unique position, a position in which the products, parts and pieces they develop and manufacture are essential, either directly or indirectly, to every industry throughout the world. Crucibles were used by the iron founders of a century past; today the foundry trade acknowledges the value of Morgan Crucible products —and the future will not ask in vain from the technologists and craftsmen who will use the knowledge and skill accumulated these past 100 years.



CENTENARY **1856-1956**

carbon and graphite—electrical, chemical and mechanical; crucibles, furnaces, refractories; radio parts, and sintered metal products.

THE MORGAN CRUCIBLE COMPANY LTD., BATTERSEA CHURCH ROAD, LONDON, S.W.11 BAT: 8822

M.C.C. 116/A

Transparent Shield

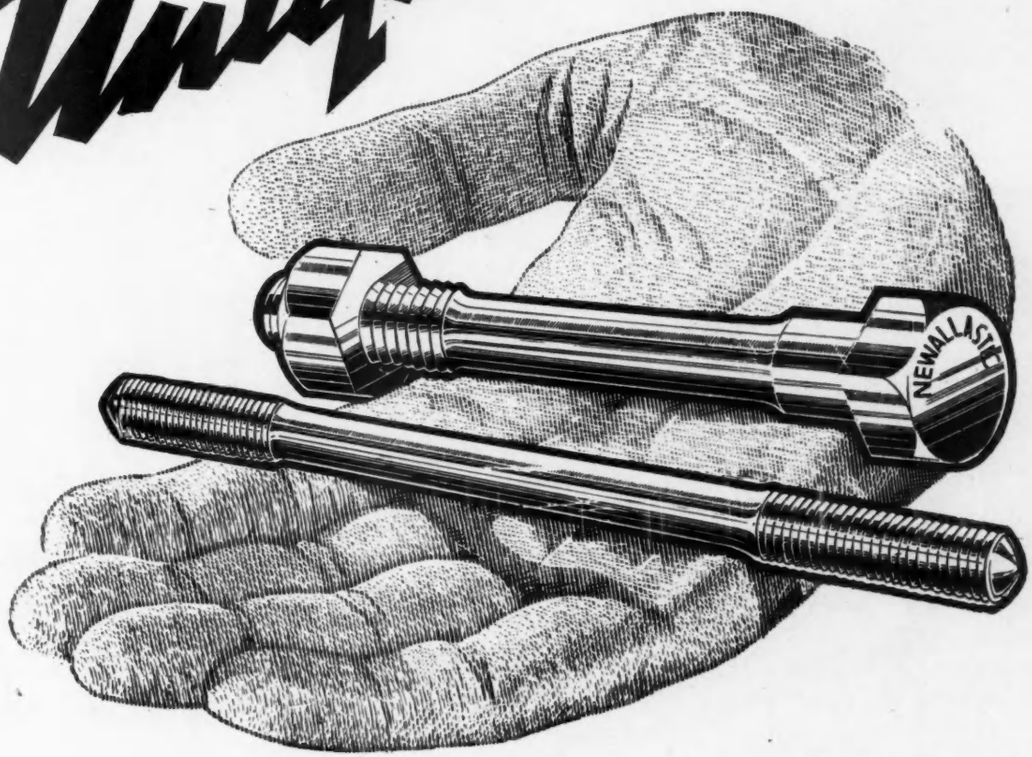
No wonder observers invariably watched the
mediæval battle "from afar". That was the only safe thing to do.
But today, in the modern factory, there are many dangerous
processes which the operative must watch closely. And thanks to
"ARMOURPLATE" glass he can do it in perfect safety.

"ARMOURPLATE" *Glass — Safety With Vision*

For further information on the use of glass in industry consult the Technical Sales and Service Department at St. Helens, ...cs.
Telephone: St. Helens 4001; or Selwyn House, Cleveland Row, St. James's, London, S.W.1. Telephone: Whitehall 5672-6
"ARMOURPLATE" *is a registered trade mark of Pilkington Brothers Limited. Supplies are available through the usual trade channe*

PILKINGTON BROTHERS LIMITED ST. HELENS, LANCASH...RE

Unique



"Newallastic" bolts and studs have qualities which are absolutely unique. They have been tested by every known device, and have been proved to be stronger and more resistant to fatigue than bolts or studs made by the usual method

C. P. Newall & Co., Ltd.

POSSILPARK GLASGOW · N

GEARS FOR INDIA

Turbine Gears Limited have, over a long period of years, assisted in the industrialisation of India through the supply of both open gears and specially designed totally enclosed gear units for use in all branches of industry in that country.

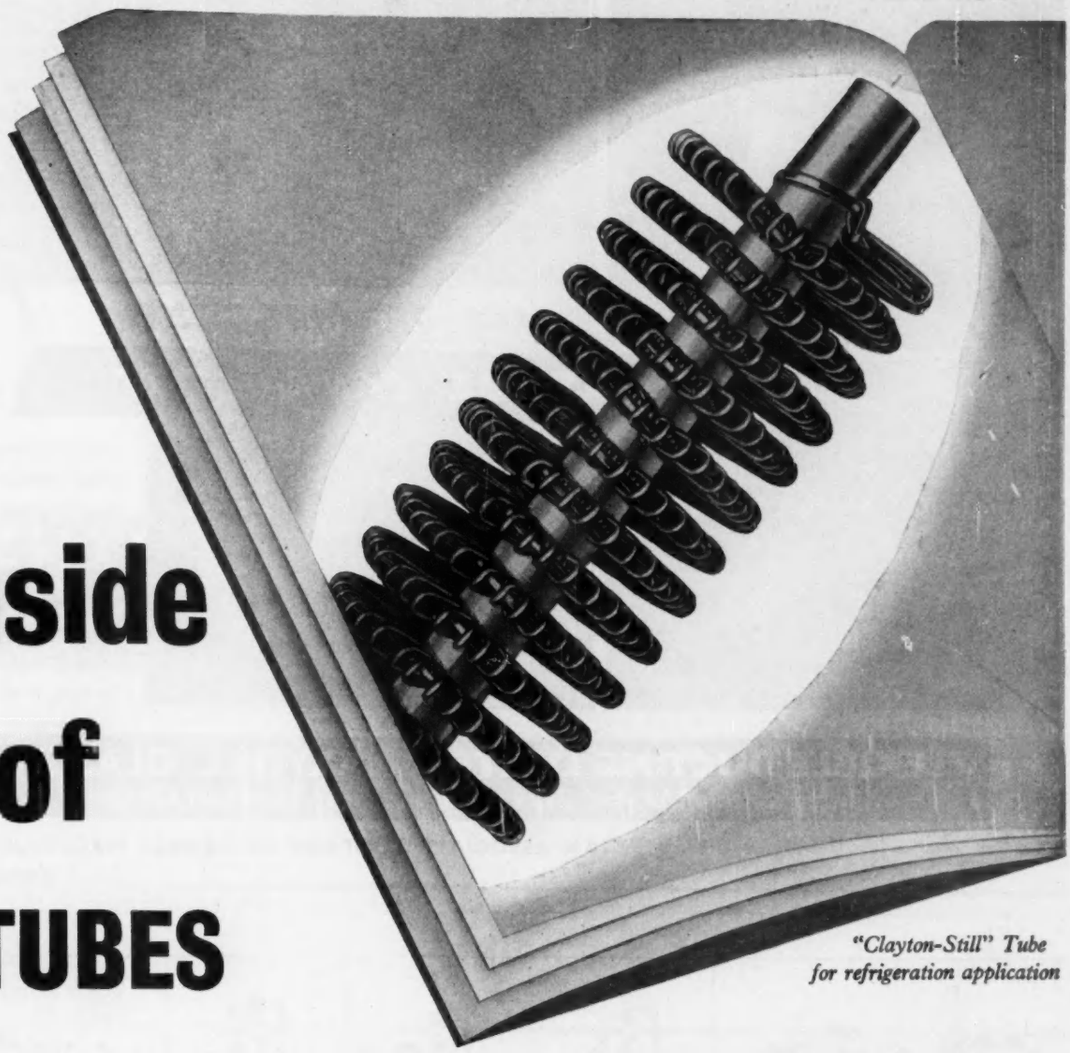
The illustration shows a double reduction double helical gear unit with combined mill pinion housing, which has been working successfully for many years driving a copper rod mill in India.

Our comprehensive catalogue illustrates and describes the wide variety of our products, and a copy will be gladly sent to you if you are interested.

Gears and gear units by **Turbine Gears Ltd**

STOCKPORT, ENGLAND

TG 11



"Clayton-Still" Tube for refrigeration application

The inside story of STILL TUBES

TAKE SEAMLESS TUBING and wire winding. Put them together with care and craftsmanship following a design evolved after years of research. And there you have the most reliable heat exchanger available—for radiators, oil coolers, heaters, refrigeration equipment, and many other products—a "CLAYTON STILL" Tube.

The large dissipating surface, improved by the air turbulence caused by the wire formation, provides a far higher co-efficient of heat transfer than any other form of tube. Result—less tubing is needed for any given job; quicker, more efficient heat dissipation no matter what your application.

USE OUR FREE ADVISORY SERVICE

Clayton Still Tubes can be drawn to fit your special requirements in brass, copper or alloys, in varying lengths and diameters. Clayton Dewandre Heat Transfer engineers are at your service, ready to examine your specific applications, to give you expert advice and recommendations.

Just 'phone or write for more information.

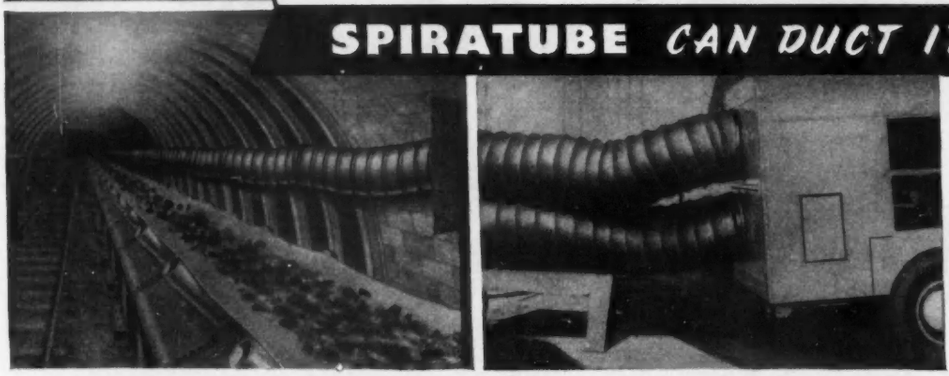
CLAYTON DEWANDRE CO. LTD.

LINCOLN · ENGLAND **Telephone Lincoln 11305-9**

ST.9

IF IT'S AIR OR AIRBORNE

SPIRATUBE CAN DUCT IT



Light materials or abrasive dust—acid fumes or combustion exhaust . . . it's a job for SPIRATUBE—the versatile flexible ducting that many leading industries are now specifying as standard equipment.

SPIRATUBE is installed quickly and easily with no costly structural alterations, heavy hangers or special fitments. Economical, too, because SPIRATUBE can be dismantled and used again and again. SPIRATUBE won't kink, or buckle, even when taken around sharp bends or along twisting passages. SPIRATUBE is light, tough, flexible, retractable and is available in a range of diameters from 3" to 30".

Write today for the SPIRATUBE Brochure which illustrates what this versatile ducting will do. Put your problem up to our Design Engineers. They will be glad to advise you without cost or obligation. The address is Flexible Ducting Limited, Maryhill, Glasgow.

FLEXIBLE DUCTING LIMITED, MARYHILL, GLASGOW, N.W,
Telephone: MARyhill 3729 Telegrams: Flexiduct,Glasgow, N.W.

AN ASSOCIATE COMPANY OF GEORGE MACLELLAN & CO. LTD
ESTABLISHED 1870

air cylinders

. . . a large range to choose from

Baldwin Pneumatics enable you to choose from probably the largest range of pneumatic equipment in the country. No fewer than 336 standard types of double-acting air cylinders are available —at competitive prices and with prompt delivery. Baldwin air cylinders are ruggedly built and are thoroughly reliable in even the most arduous working conditions.

Baldwin Pneumatics also manufacture a wide range of top quality control and pilot valves, and associated accessories which will adequately cover all your requirements.

Further details are included in Baldwin Brochure No. S-503. available on request.

BALDWIN *Industrial Pneumatics* BP

BALDWIN INSTRUMENT COMPANY LTD., DARTFORD, KENT Telephone: 2948

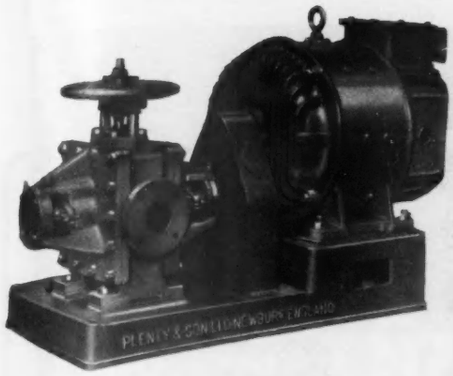
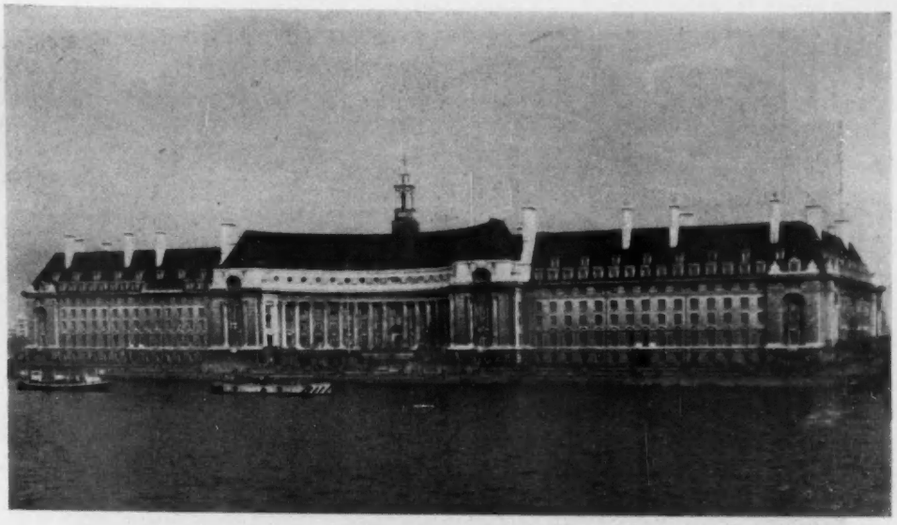


Illustration of a 60 gallons per minute, variable flow Plenty Pump, coupled to a flameproof motor.



Veiw of County Hall from the river.

PLENTY PUMPS

This advertisement is the 12th in the series, depicting famous buildings with Plenty Pumps on the heating installations.

COUNTY HALL, LONDON

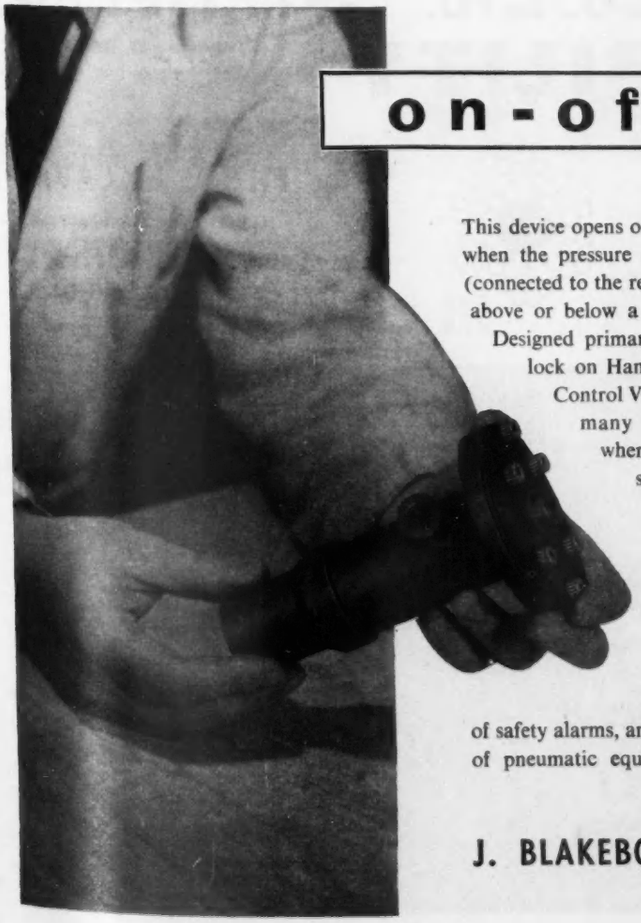
This famous London landmark is the headquarters of London County Council. This large building is heated by oil-fired boilers and the pumps which supply the fuel oil (CTF 200) are Size AB Plenty Pumps, with a capacity of 1,000 gallons per hour each. They were supplied by Messrs. Laidlaw Drew Limited of Edinburgh.

Send your pumping problems or write for details to:

PLENTY & SON LTD., Newbury, Berks.

Telephone: NEWBURY 7 Telegrams: PLENTY, NEWBURY.

E.



on-off air relay

This device opens or closes one air circuit when the pressure of another air supply (connected to the relay diaphragm) varies above or below a predetermined value. Designed primarily for use as an air lock on Hammel-Dahl Diaphragm Control Valves, it is now finding many other applications, where conditions call for sturdy reliability rather than the high sensitivity of the more delicate "instrument" type relay. Examples of it's use include the actuation of sequencing devices, operation of safety alarms, and the isolating of units of pneumatic equipment in emergency.

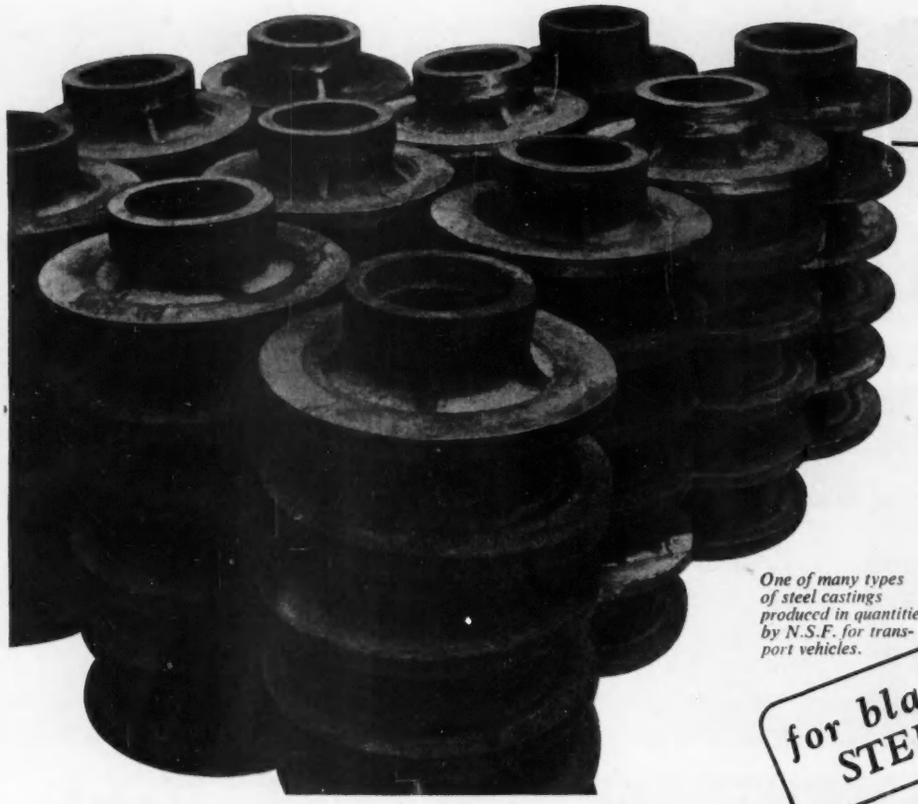
It is of rugged construction; weatherproof; of high capacity; gives positive tight shut-off; and is adjustable in service.

OPERATING DATA	
SET POINT	Adjustable from 3 to 20 psig.
MAX. PRESSURE ON DIAPHRAGM	200 psig.
MAX. SUPPLY PRESSURE	100 psig.
THROTTLING RANGE (Change in pressure on diaphragm to move from closed to full open position).	3 psi. (with downstream pressure constant).

BLAKEBOROUGH

J. BLAKEBOROUGH & SONS LTD., BRIGHOUSE, ENGLAND

blb.917



One of many types of steel castings produced in quantities by N.S.F. for transport vehicles.

N S F

An increasing number of well known engineering firms are using N.S.F. castings because of their good finish and dependability.

Modern foundry practice, including electric furnaces capable of 150 tons of steel castings a week, enables good deliveries to be made of castings from a few pounds up to 25 cwts.

for black or machined STEEL CASTINGS

National Steel Foundry

(1914) LTD. KIRKLAND WORKS, LEVEN, FIFE. PHONE LEVEN 693. LONDON OFFICE, ALEXANDRA HOUSE, KINGSWAY, W.C.2

WM. JAS. GLOVER & CO. LTD. ST. HELENS

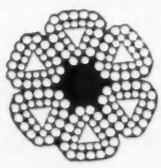
ESTABLISHED 1918

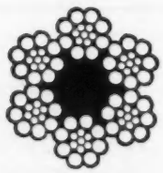
RELIABILITY

Telephone: ST. HELENS 2030
Telegrams: "GLOVERS," ST. HELENS

SOLE MAKERS OF

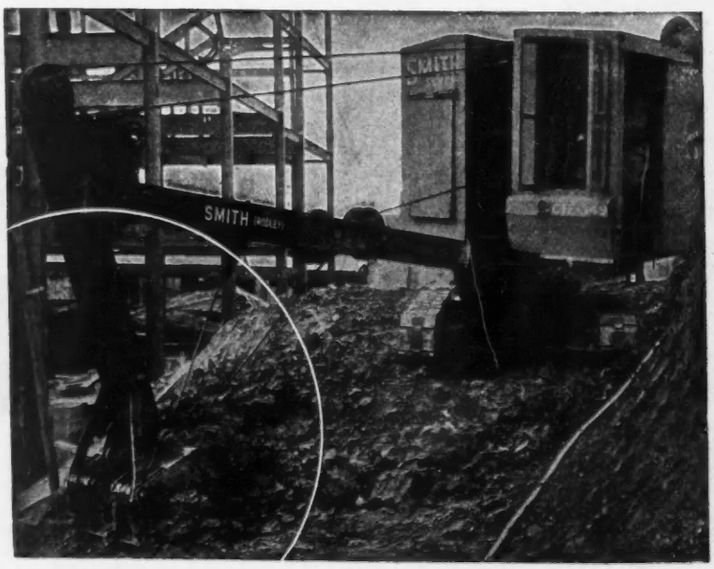
"GLOVER'S BEST"
STEEL WIRE ROPES
FOR ALL PURPOSES



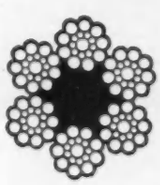


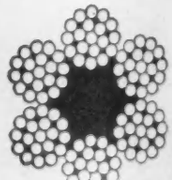
THE EXCAVATOR
ILLUSTRATED MANUFACTURED BY
THOMAS SMITH & SONS
(RODLEY) LTD.,
RODLEY, Near LEEDS.

SPECIAL TYPES OF CRANE AND EXCAVATOR ROPES TO SUIT ALL CONDITIONS



OUR ROPES ARE USED ON SMITH'S EXCAVATORS.





NEEDLE BEARINGS
incorporating **CAGES**

Why use a cage?

Because it provides the logical means of presenting the needles in true rolling alignment to the axis of the shaft. The needles cannot skew across the track when mounted in the INA CAGE. You obtain Higher Speeds, Closer Running Clearances and even Load Distribution across full width of the rolling members of the bearing.

INA NEEDLE BEARINGS LTD.,
Swiss House, 34-35, Fitzroy Square, London, W.1
Telephone: MUSeum 3161. Telegrams: Inabeco, Wesdo, London

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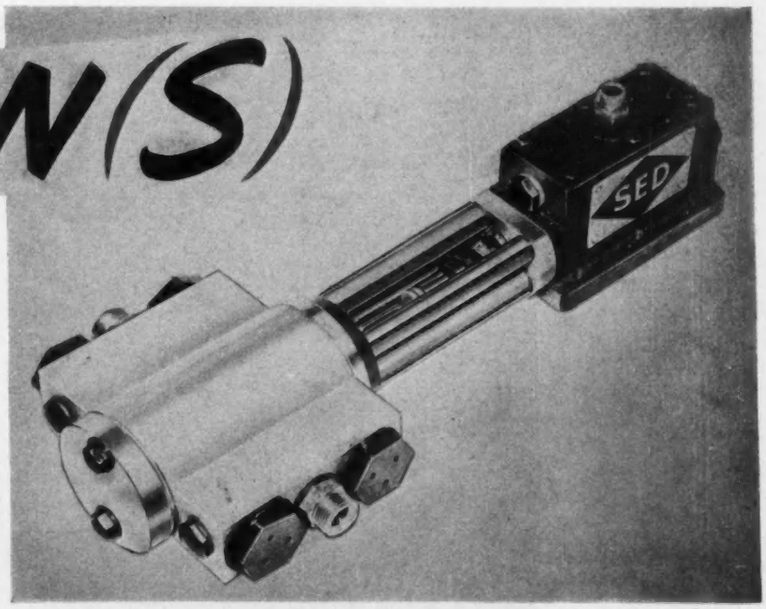


The S.E.D
'NEUMO' Mk. III
PNEUMATICALLY OPERATED PUMP UNIT

THE MOTOR

- ★ Two moving parts only.
- ★ Hardened and ground piston and valve.
- ★ Cast iron body with honed bore.
- ★ Non-stalling.
- ★ Negligible air consumption.
- ★ High power output.

THE PUMP

- ★ Double acting.
- ★ High efficiency.
- ★ Self-contained valves.
- ★ Easily serviced.
- ★ Pumps liquids up to 200 deg. F.

SIMPLICITY MEANS RELIABILITY

TYPICAL PERFORMANCE FIGURES

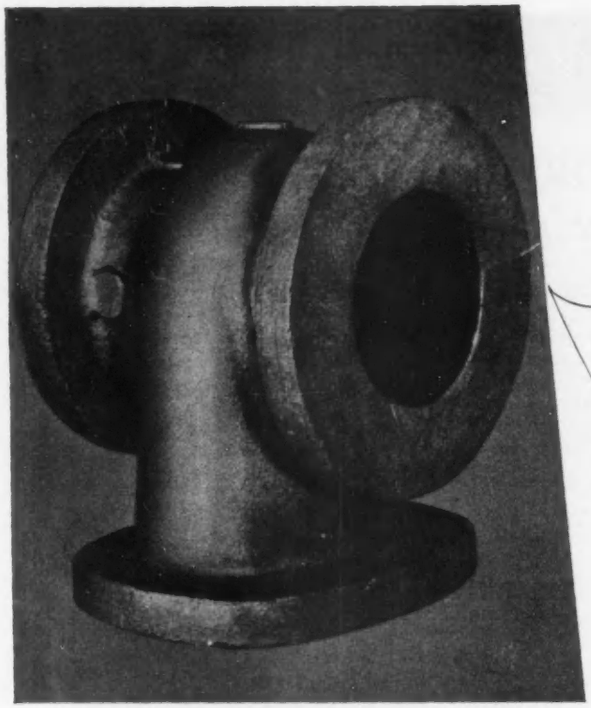
Air Pressure	60 lbs. P.S.I.	60 lbs. P.S.I.
Consumption	2½ Cu. F.P.M.	2½ Cu. F.P.M.
Delivery	45 gals. P.H.	120 gals. P.H.
Del. Pressure	30 lbs. P.S.I.	5 lbs. P.S.I.

WIDE RANGE

Owing to the design and materials employed in its construction, the "Neumo" Mk. III Pump Unit is capable of handling a very wide range of materials such as paint at 200 deg. F., petrol, oils, from paraffin to high viscosities, Solvex, Mangersol, Basol, Trichlorethylene and all types of cellulose solvents, etc.

Send for further details to:—

(Dept. EG), KINGSBOURNE PRODUCTS LTD., SOUTH COAST ROAD, PEACEHAVEN, SUSSEX Tel. Peacehaven 2115



THEY SPEAK FOR THEMSELVES

HIGH & LOW PRESSURE

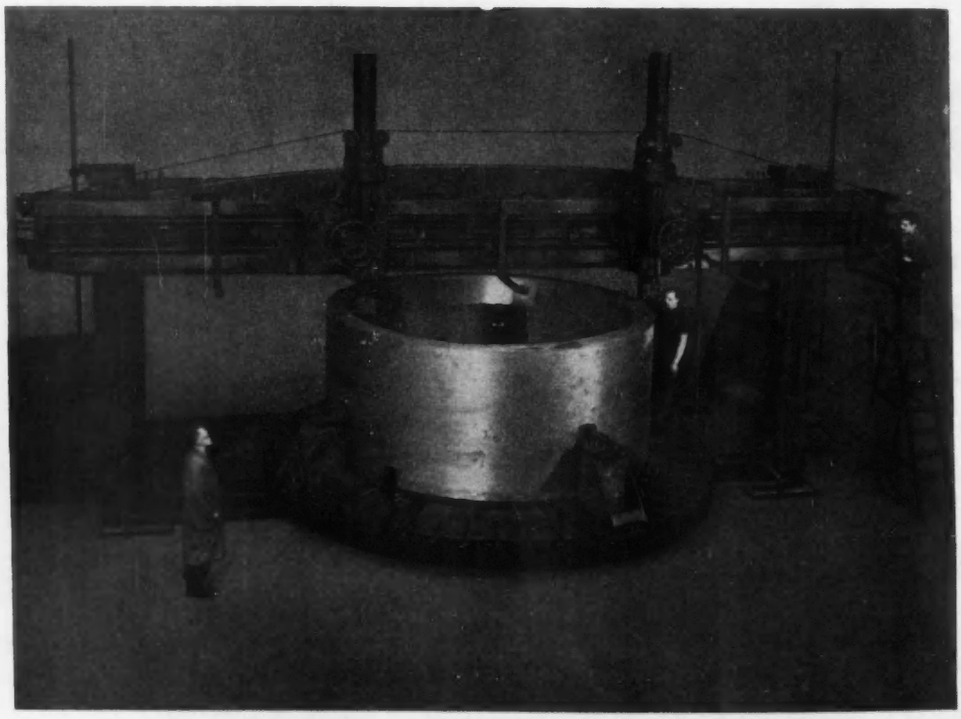
VALVE & HEADER CASTINGS

Our foundry is regularly supplying castings for the Petroleum Industry where soundness is vital. In fact, we specialise in the production of castings where quality is essential.

We offer a personal service in close collaboration with manufacturers, and our technical staff is always available for consultation. Call us in early on your next quality job.

THE FARINGTON STEEL FOUNDRY
OF LEYLAND MOTORS LTD. · LEYLAND · LANCASHIRE

This Machine can Swing 23′ 0″ diar.



The Section of the Slab is 5′ 0″ × 10″

A MAGNET FRAME
for a ROLLING MILL MOTOR
PRESSED, WELDED and MACHINED
BY
CHARLES McNEIL, LTD.
GLASGOW

something new

National Plastics

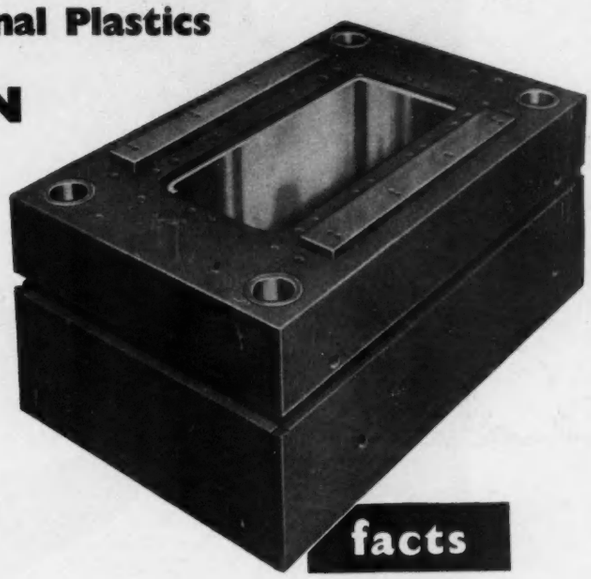
NP 39

TOOLMAKING DIVISION

now makes moulds for 'the trade'

National Plastics experience, skill and reliability as mould makers is now available for the first time to moulder firms looking for tool making capacity.

Quite a few old timers at our Walthamstow factory have been making moulds for plastics for thirty five years. Building on a nucleus of this calibre our tool division has now so expanded its plant and skilled personnel that it can make moulds for the trade. This in addition to its normal toolmaking work for National Plastics customers, which is in no way affected.



facts

. . . we made the mould, weighing twelve tons, for the only plastics television CONSOLE cabinet outside U.S.A.

our equipment includes FIVE Keller automatic copying machines.

we have made more radio cabinet moulds than any other toolmaking shop in Great Britain.

we have to our credit many highly ingenious automatic 'injection' moulds for moulding thermoplastics.

NATIONAL PLASTICS TOOLS

NATIONAL PLASTICS (SALES) LTD. Sales Organisation for BRITISH MOULDED PLASTICS LTD., Avenue Works, Walthamstow Avenue, London, E.4. *LARkswood 2323*

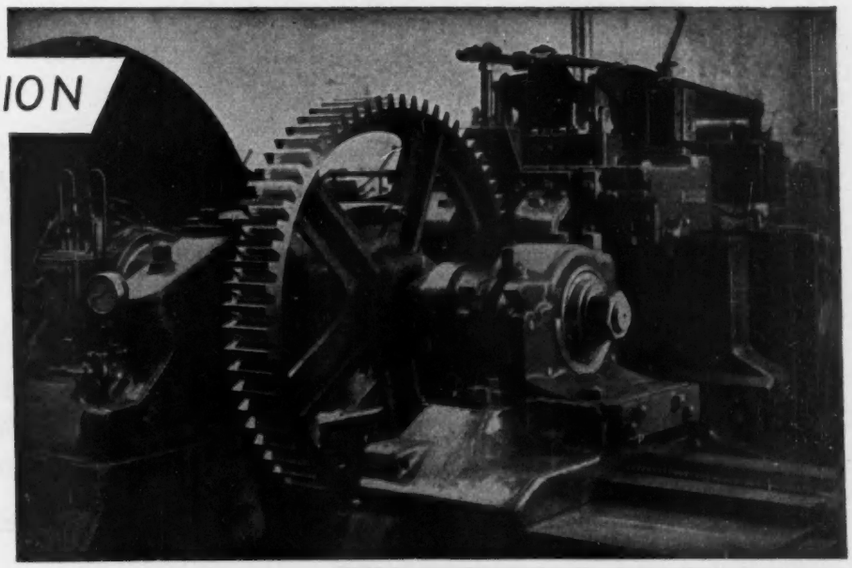
TO ANY SPECIFICATION

ABBOT

MACHINE CUT

GEARS

in any material



We guarantee the teeth of all wheels cut by us to be correct, and all work is examined and checked before being despatched. Each gear wheel of a pair is run in correct relative position to the other in a special gear testing machine. No perceptible backlash is allowed in our gearing, and thus we can ensure very silent running.

Our booklet 'MACHINE CUT GEARS contains much information of interest and use to engineers.

A copy will be sent on request.

SPUR WHEELS · WORM GEARING · SPIRAL WHEELS
BEVEL WHEELS · RACKS · FIBRE PINIONS

The ABBOT ENGINEERING Co. Ltd.
22 SMITHHILLS . PAISLEY
Telephone: PAISLEY 4272 Telegrams: "ABBOT, PAISLEY."

Power for Paper Mills . . .

Boilermakers for 80 years, we have supplied a wide range of industries with special boiler equipment to suit individual requirements, in this country and abroad.

We shall be pleased to give advice and assistance on your power problem — whether for new plant or modification to existing units.

Recently Completed Contracts Include:

- ★ Wiggins Teape & Co. (1919) Ltd., Devon Valley Mills.
- ★ Caldwell Paper Mill Co. Ltd.
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- ★ Thames Board Mills Ltd., Warrington.
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Current Contracts Include:

- ★ Thames Board Mills Ltd.
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POWER FOR PAPER MAKING AND EVERY TYPE OF INDUSTRIAL PLANT

CLARKE, CHAPMAN & CO. LTD., VICTORIA WORKS, GATESHEAD, 8, CO. DURHAM
Telephone: Gateshead 72271 (10 lines) Telegrams: "Cyclops", Gateshead

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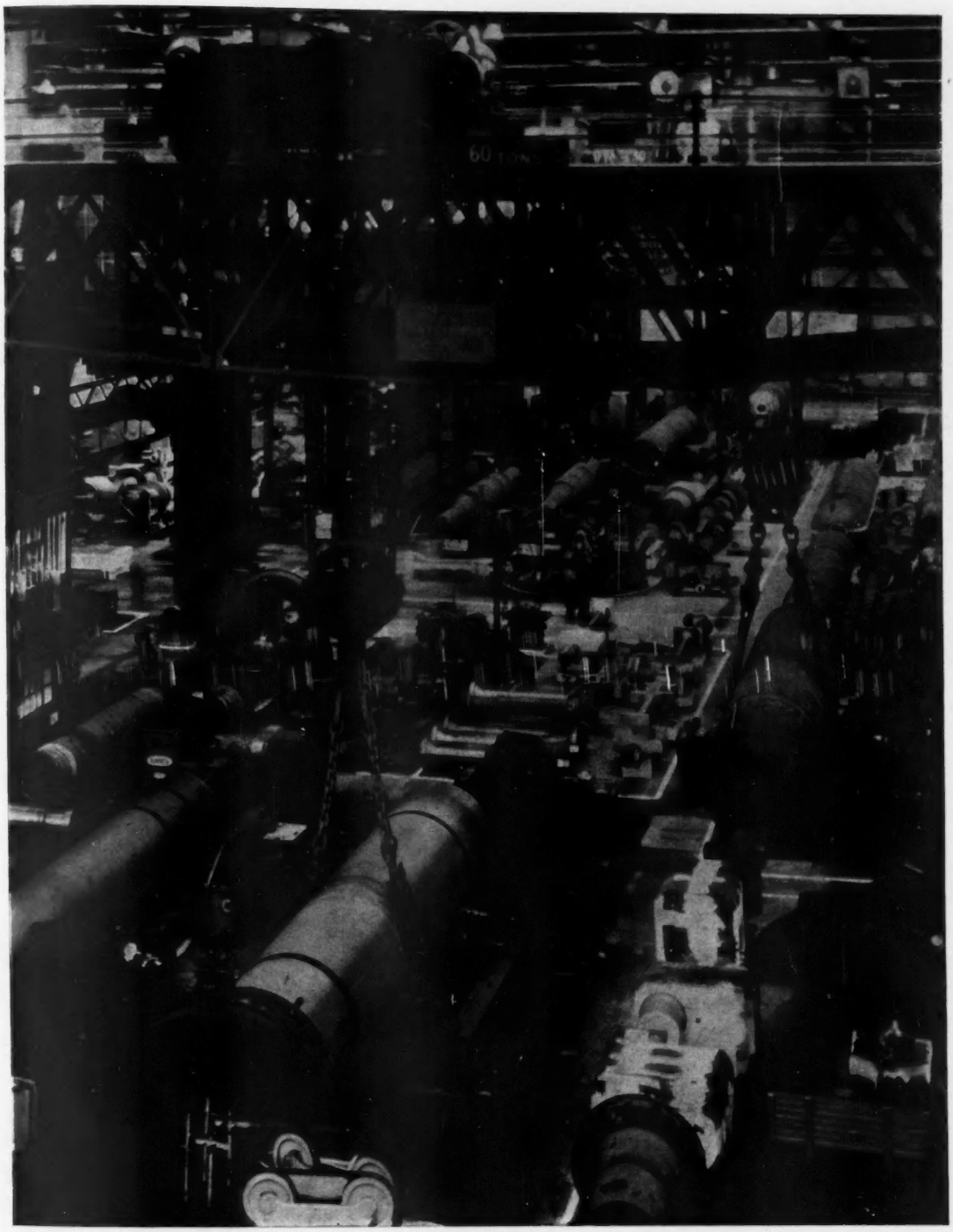


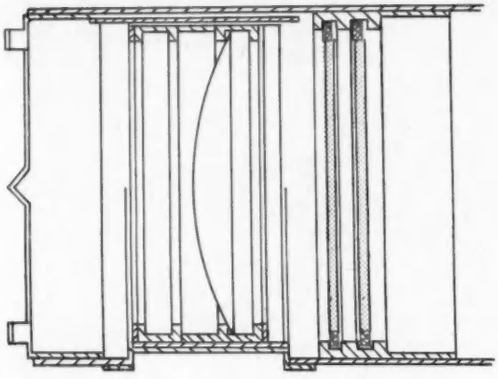
MACHINING OF HEAVY FORGINGS

by FIRTH BROWN

ALLOY STEELMAKERS · FORGEMASTERS · STEEL FOUNDERS · HEAVY ENGINEERS

THOS. FIRTH & JOHN BROWN LIMITED · SHEFFIELD

THE SIMPLEST AND MOST ECONOMIC MEANS OF FIXING ★



Lenses in a Tube

IS TWO RETAINERS

★ *That's why The Rheostatic Co Ltd selected for their Ler Control*

SALTER

"TRUARC"
Regd. Trade Mark

RETAINERS

To Geo. Salter & Co. Ltd., West Bromwich. Please send details and samples of Salter Truarc Retaining Rings to:

Name .....

Firm .....

Address.....

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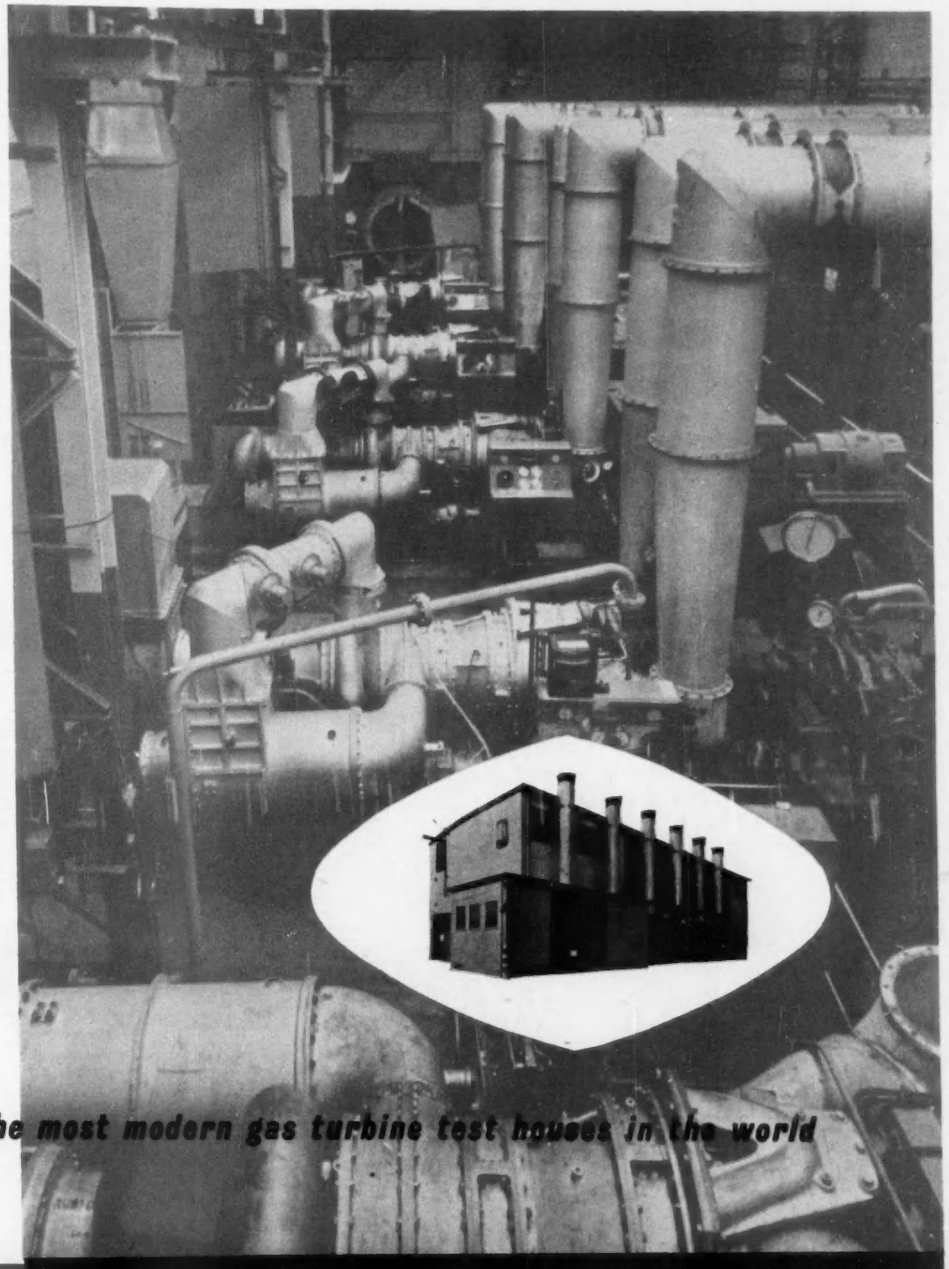
☐ Send representative ☐ Letter attached

Put X as necessary J28

IF YOU WISH TO SOLVE YOUR FIXING PROBLEMS AS EASILY, JUST POST THE COUPON FOR DETAILS.

GEO. SALTER & CO LTD., WEST BROMWICH

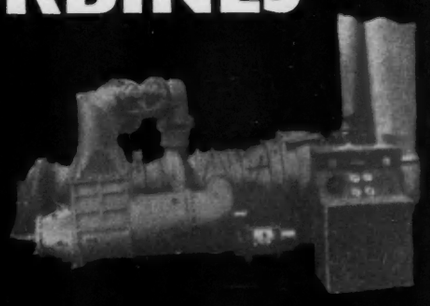
Ruston gas turbines are tested on site fuels



...in one of the most modern gas turbine test houses in the world

RUSTON **GAS TURBINES**

These modern power units are in world-wide demand for a variety of applications and are going into service on all five continents



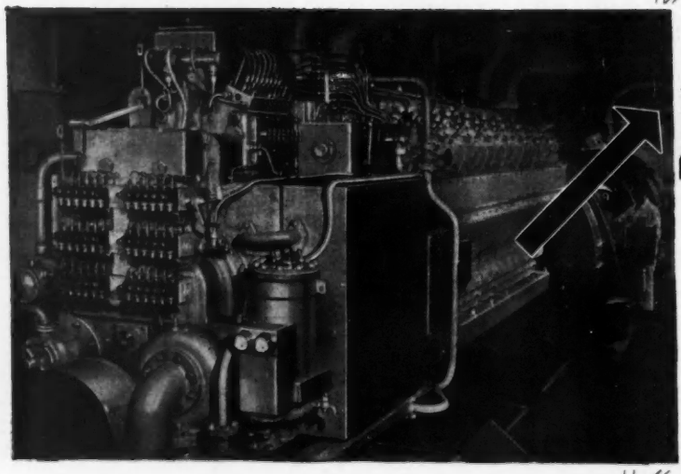
RUSTON & HORNSBY LTD · LINCOLN · ENGLAND

ASSOCIATED WITH DAVEY, PAXMAN & CO. LTD., COLCHESTER

Power and Performance

The photograph shows two "Crossley" "HSVee" type sixteen cylinder Scavenge Pump Diesel Engines each developing 1750 b.h.p. at 500 revolutions per minute, installed at the Central Electricity Authority's Power Station, Haverfordwest, South Wales.

Backed by the experience gained over a period of ninety years, Crossley Diesel Engines provide a soundness in design and an economy in running that guarantee efficiency. We are more than able to help you solve your particular power problems.

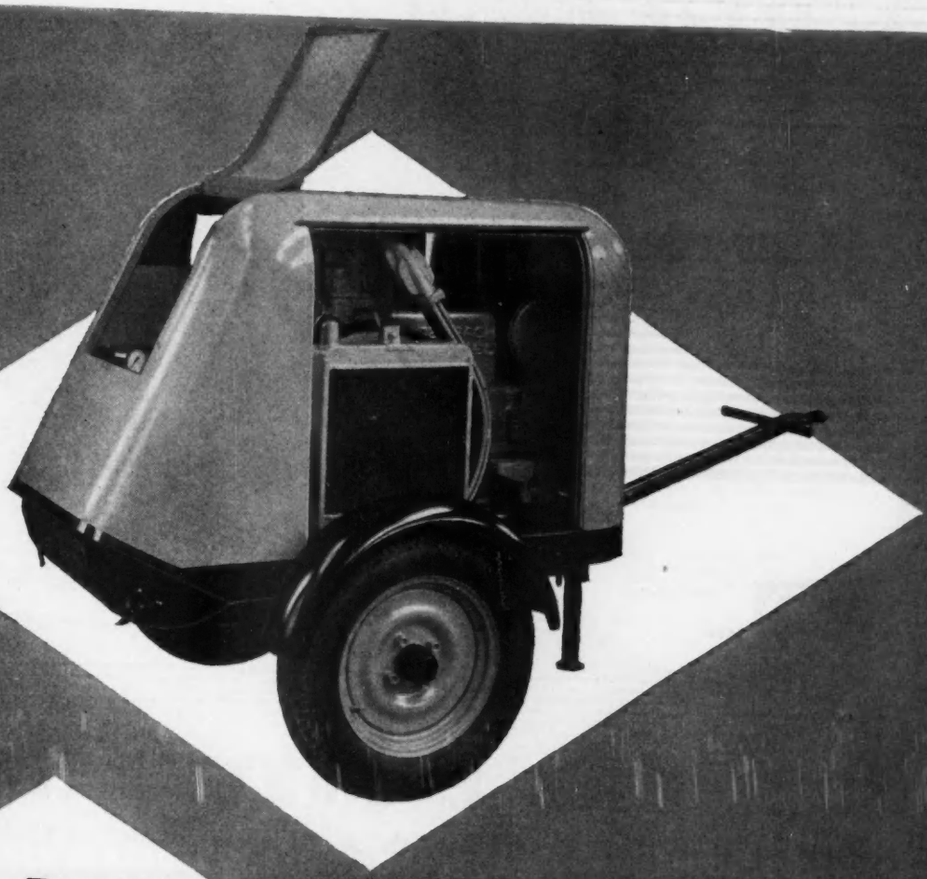


CROSSLEY DIESEL ENGINES

CROSSLEY BROTHERS LIMITED · OPENSHAW · MANCHESTER 11

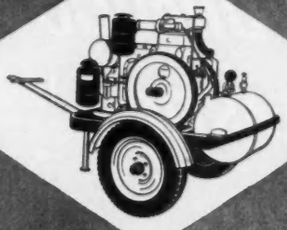
London Office: Langham House · 308 Regent Street W.1.

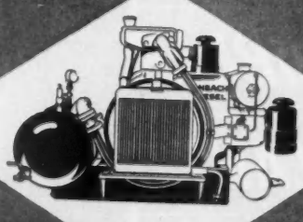
C 397



£475 BUYS THE JENBACH

THE BIGGEST DIESEL COMPRESSOR BARGAIN IN BRITAIN TODAY!





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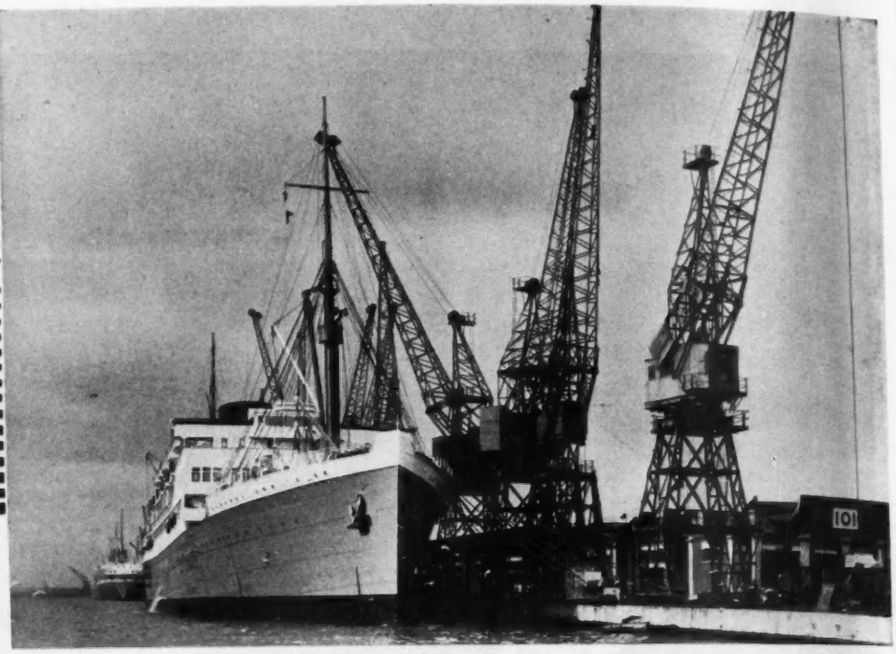

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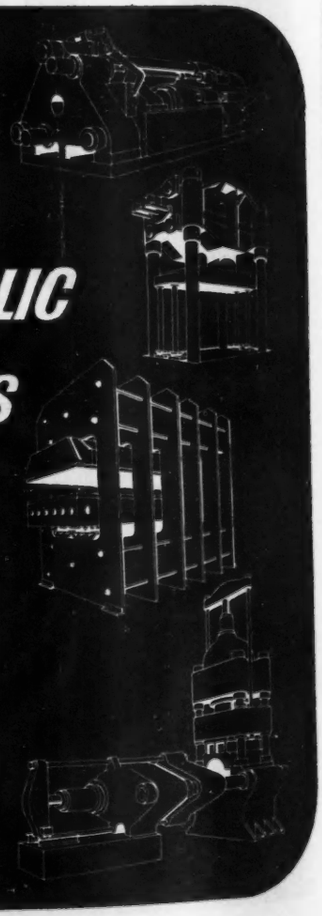

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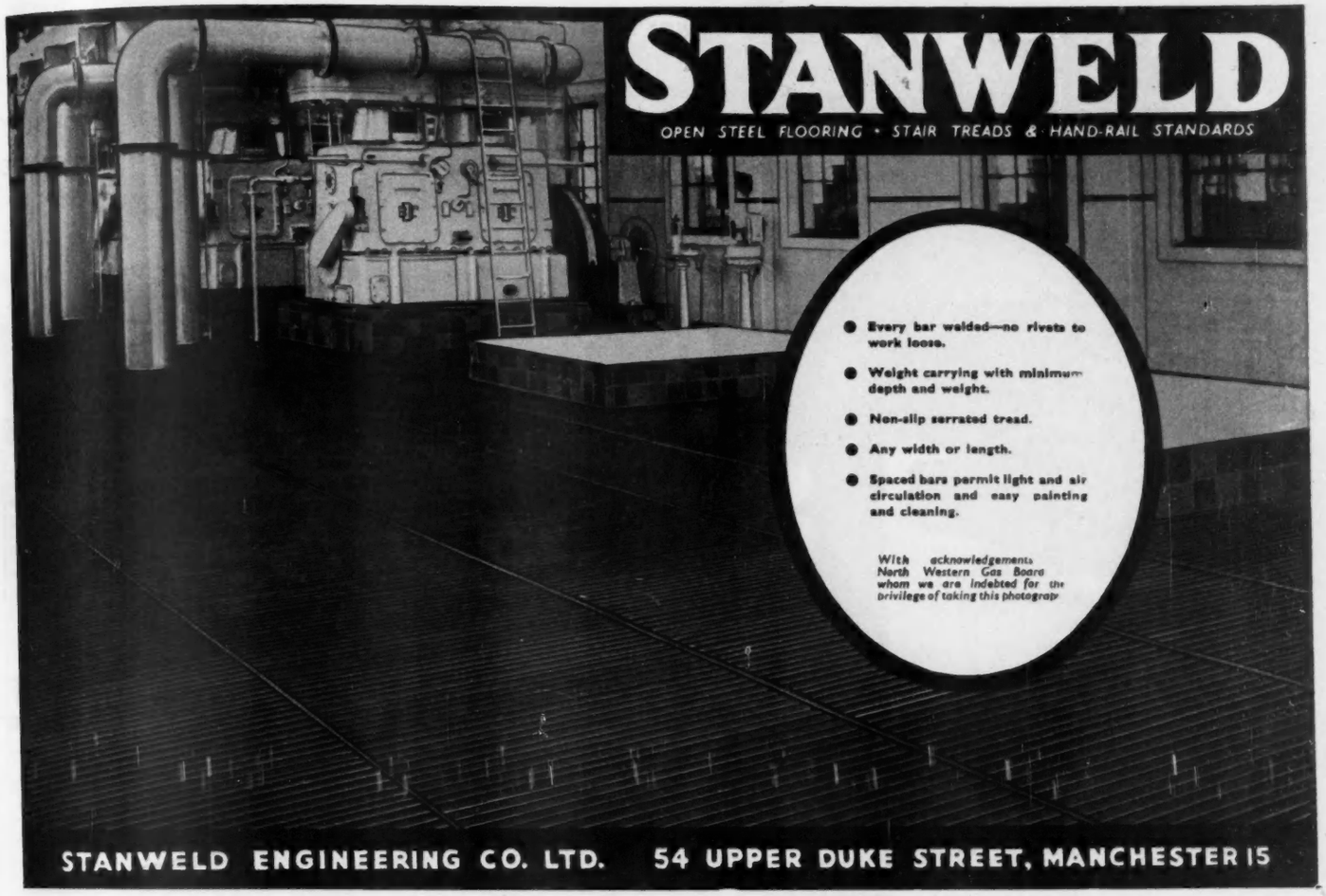
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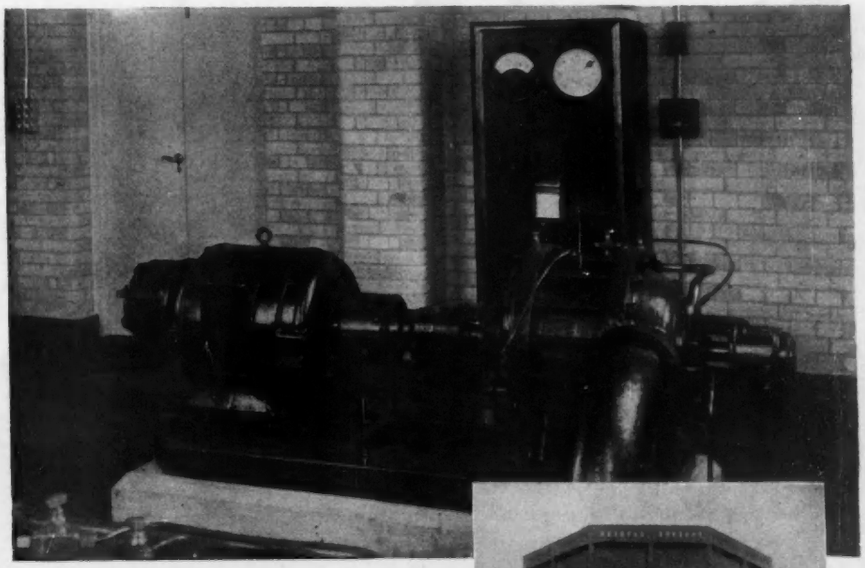
THE LEVEL BEST . . . . remote indication and control equipment by EVERSHED



Yet another example of the successful operation of Evershed remote indication and control equipment is the recent installation at the Thingoe Rural District Council's Rushbrooke Pumping Station.

A telemeter water level transmitter is installed at the water tower and is connected by a two wire Post Office telephone line to the Pumping Station some four miles away, where a cubicle housing the level indicator, graphic water level recorder and pump control relay is situated. Adjustable high and low level contacts are provided on the pump control relay which operate an internally mounted power relay. The pump is thereby automatically controlled to maintain level in the water tower. The pump feeding the water tower draws its supply from a surface tank where the level is maintained by " Noflote " Control apparatus. Supply of water to this surface tank is provided by a borehole pump which is also controlled by " Noflote " apparatus.

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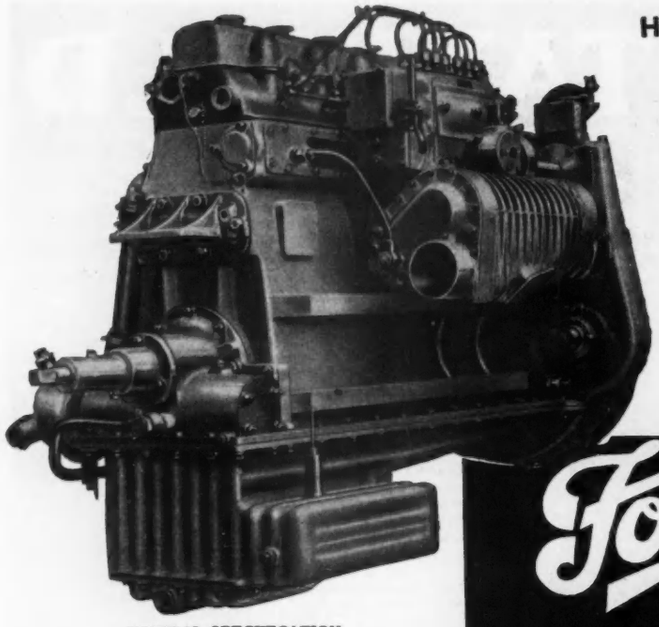

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GENERAL SPECIFICATION

No. of cylinders	Six
Bore	85 mm. (3·35 in.)
Stroke	120 mm. (4·73 in.)
C.C. per cylinder	661 c.c. (41·6 cu. in.)
Total cubic capacity	4090 c.c. (250 cu. in.)
Maximum B.H.P. at 1800 r.p.m.	105
B.M.E.P. at 1800 r.p.m.	93 lbs./sq. in.
Maximum torque at 1500 r.p.m.	350 lbs./ft.
Compression Ratio	14-1 approximate
Firing order	1, 5, 3, 4, 2, 6.
Piston speed at 1800 r.p.m.	1417 ft. min.
Fuel consumptoin	Under 40 lbs. B.H.P. hr.
Oil consumption	Less than 1% fuel oil

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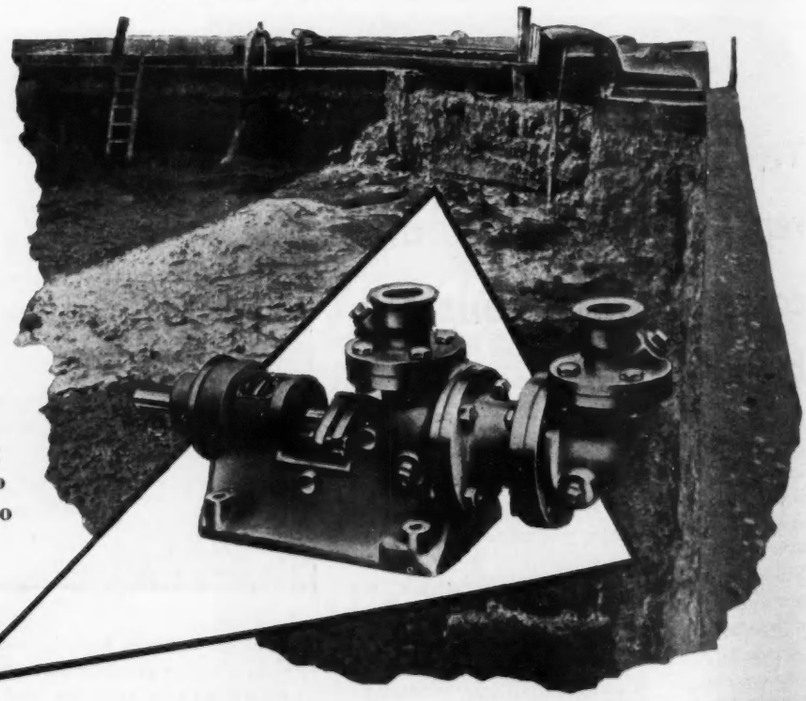

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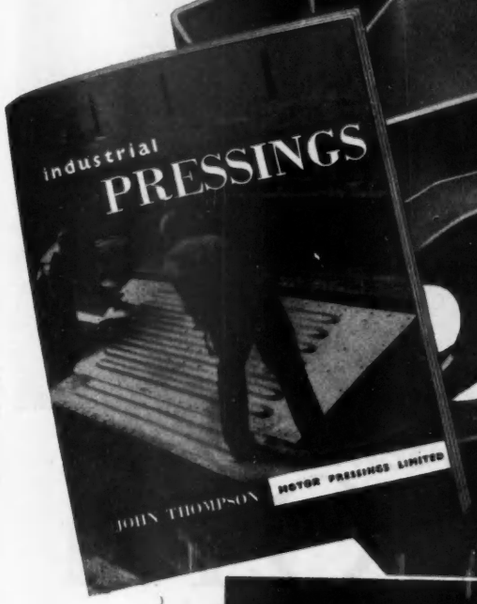

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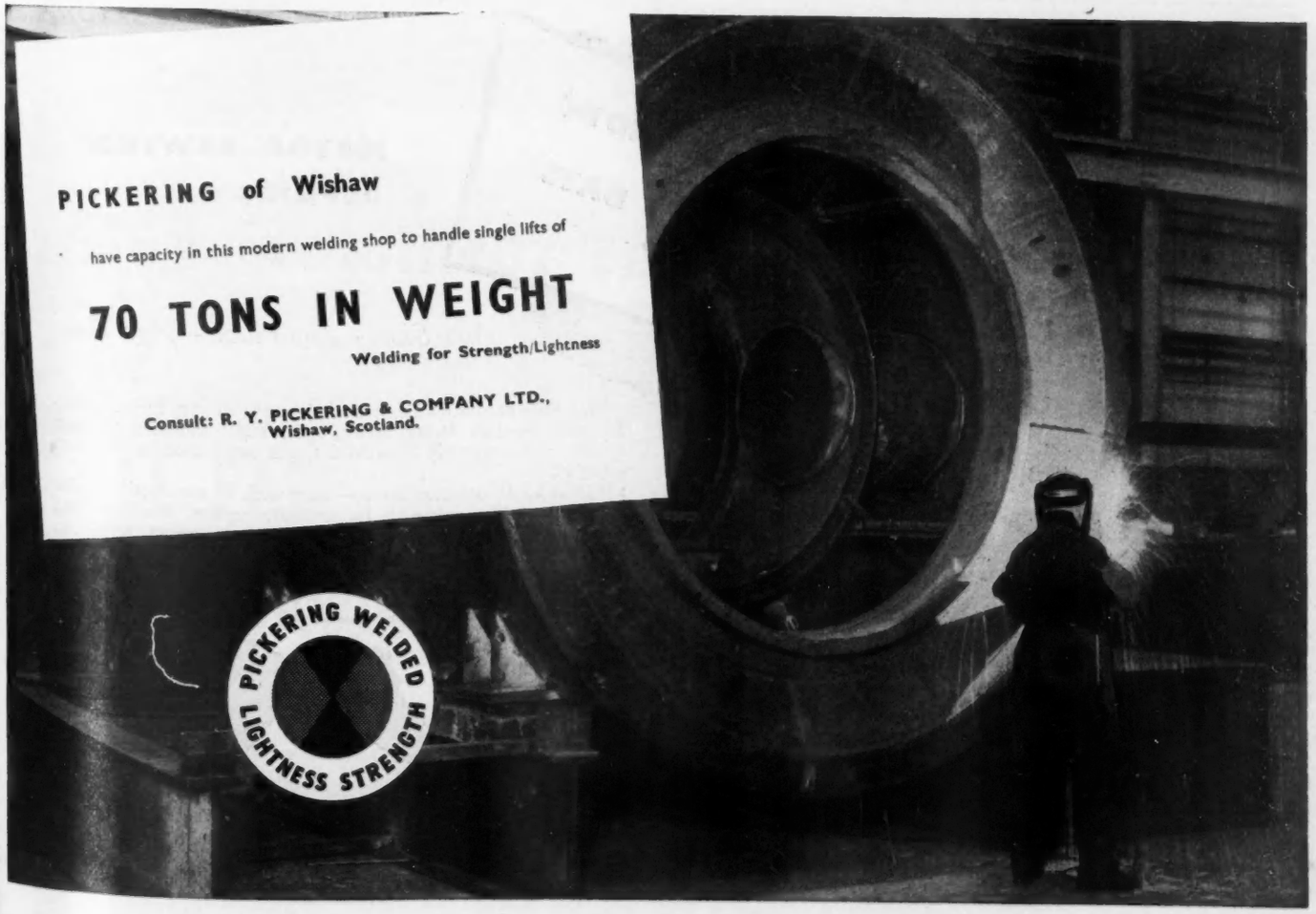

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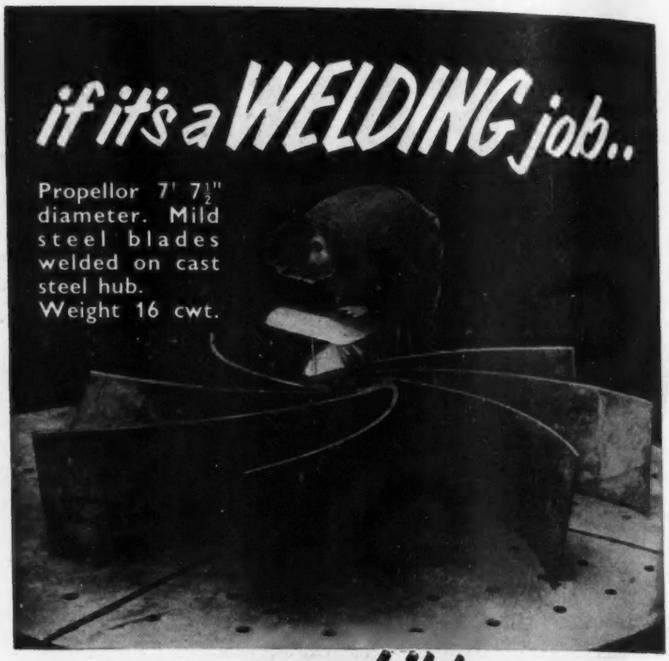

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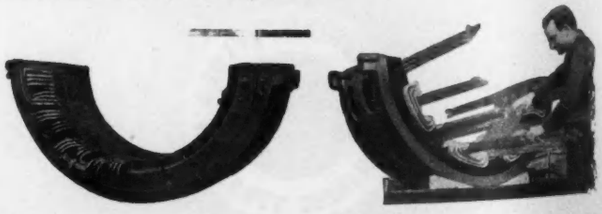

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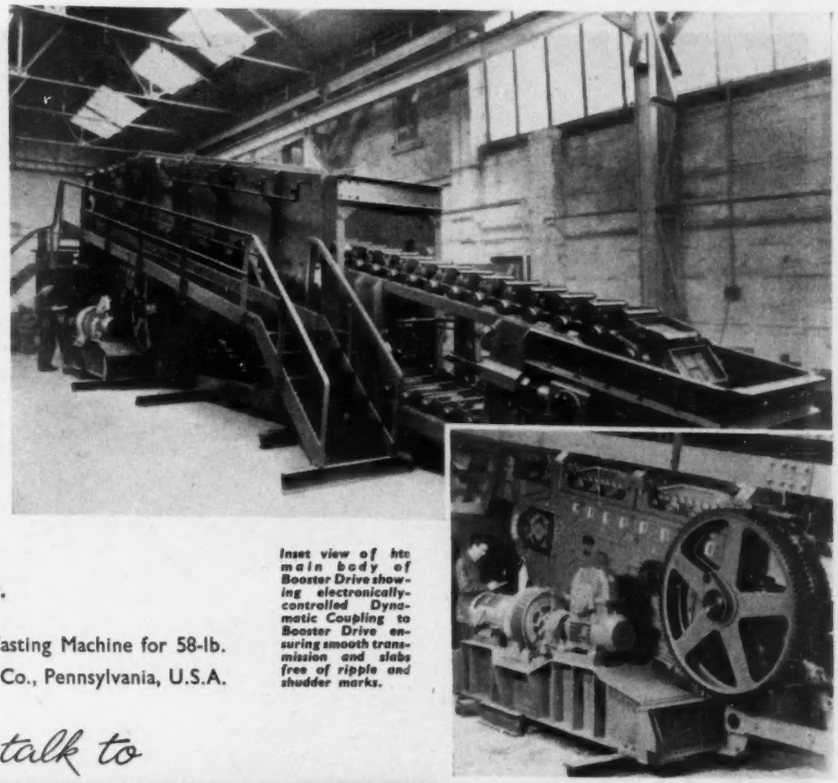
Talking about

ZINC SLAB CASTING MACHINES



It is not unnatural that SHEPPARD'S of BRIDGEND—with their vast experience in manufacturing Ingot Casting Machines for the Non-Ferrous and Ferrous Trades—should apply this knowledge to the problem (hitherto unsolved) of ZINC SLAB CASTING by machinery.

Illustrated is a SHEPPARD Booster Driven Slab Casting Machine for 58-lb. zinc slabs recently supplied to the St. Joseph Lead Co., Pennsylvania, U.S.A.

Inset view of the main body of Booster Drive showing electronically-controlled Dynamatic Coupling to Booster Drive ensuring smooth transmission and slabs free of ripple and shudder marks.

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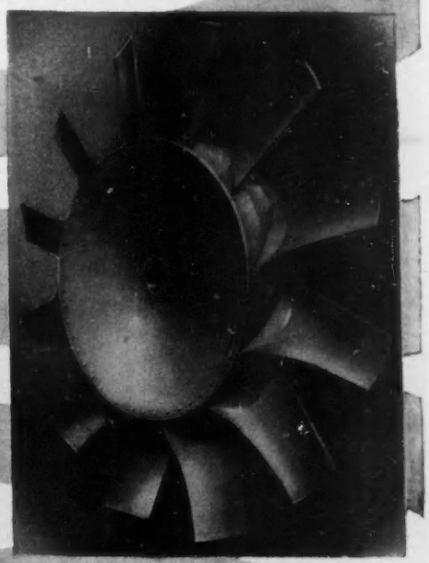

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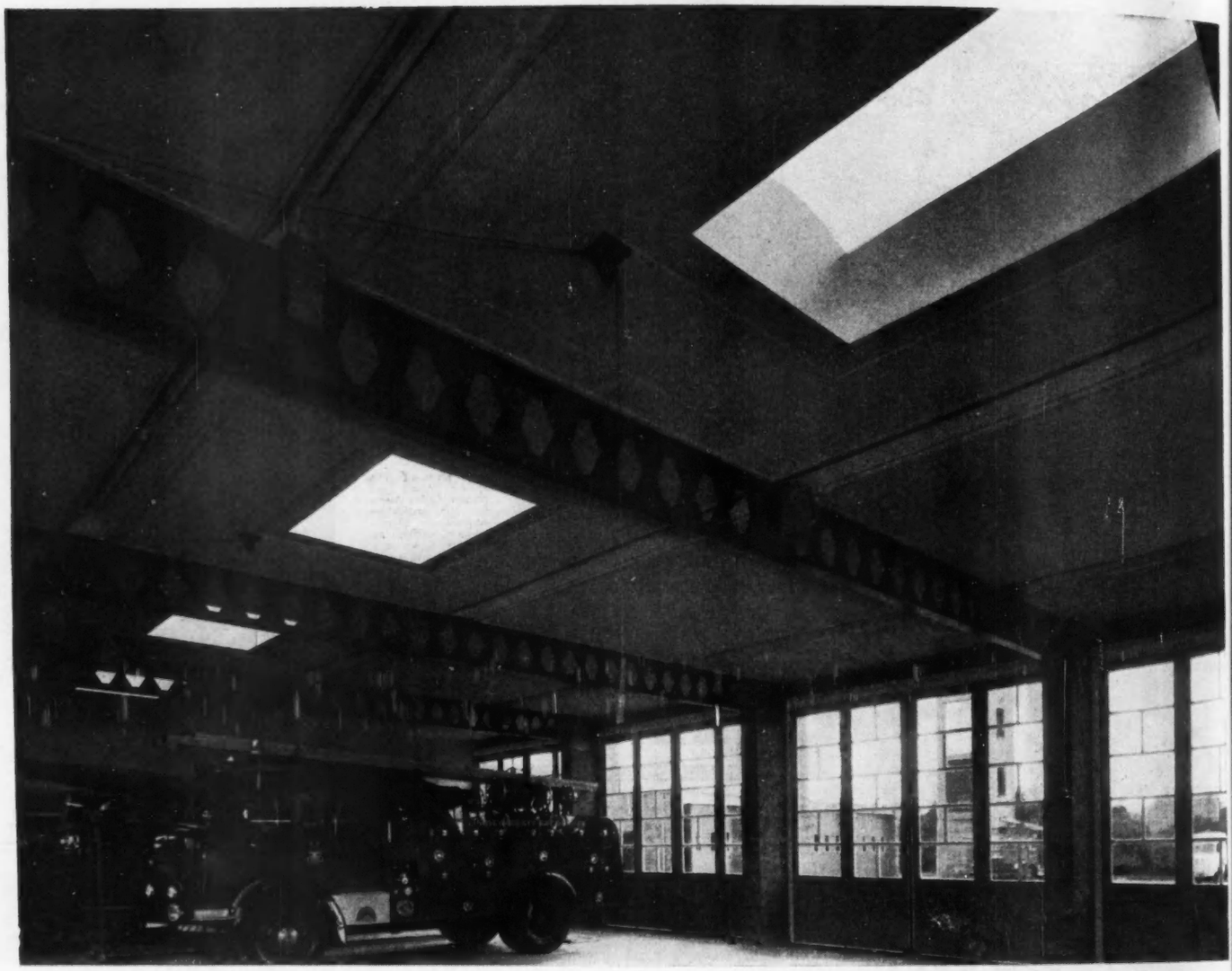
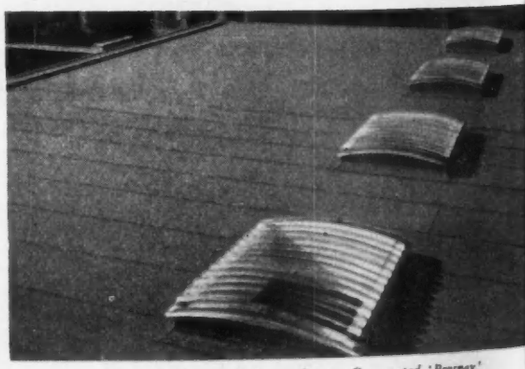


Interior of Lindsey County Council Fire Brigade and Ambulance Station Gainsborough, Lincs. Roof windows are in Corrugated 'Perspex'.

Modern Fire Station fitted with Corrugated 'PERSPEX' roof lights

CORRUGATED 'PERSPEX' is unequalled as a roofing material in all buildings where toughness, durability and high light transmission are important. Corrugated 'Perspex' will stand up to any amount of external weathering, as well as extreme heat or cold. It represents a considerable saving over conventional materials.

Corrugated 'Perspex' is very light, easy to handle, and not expensive to install. For those rare instances in this country where diffused daylight may be more desirable, Opal 'Perspex' is available. Originally developed for intense light conditions overseas, Opal Corrugated 'Perspex' diffuses daylight efficiently.



View of the roof from above. Corrugated 'Perspex' transmits a very high proportion of daylight.

It's as clear as daylight—it must be

Corrugated 'PERSPEX'

'Perspex' is the registered trade mark for the acrylic sheet manufactured by I.C.I.

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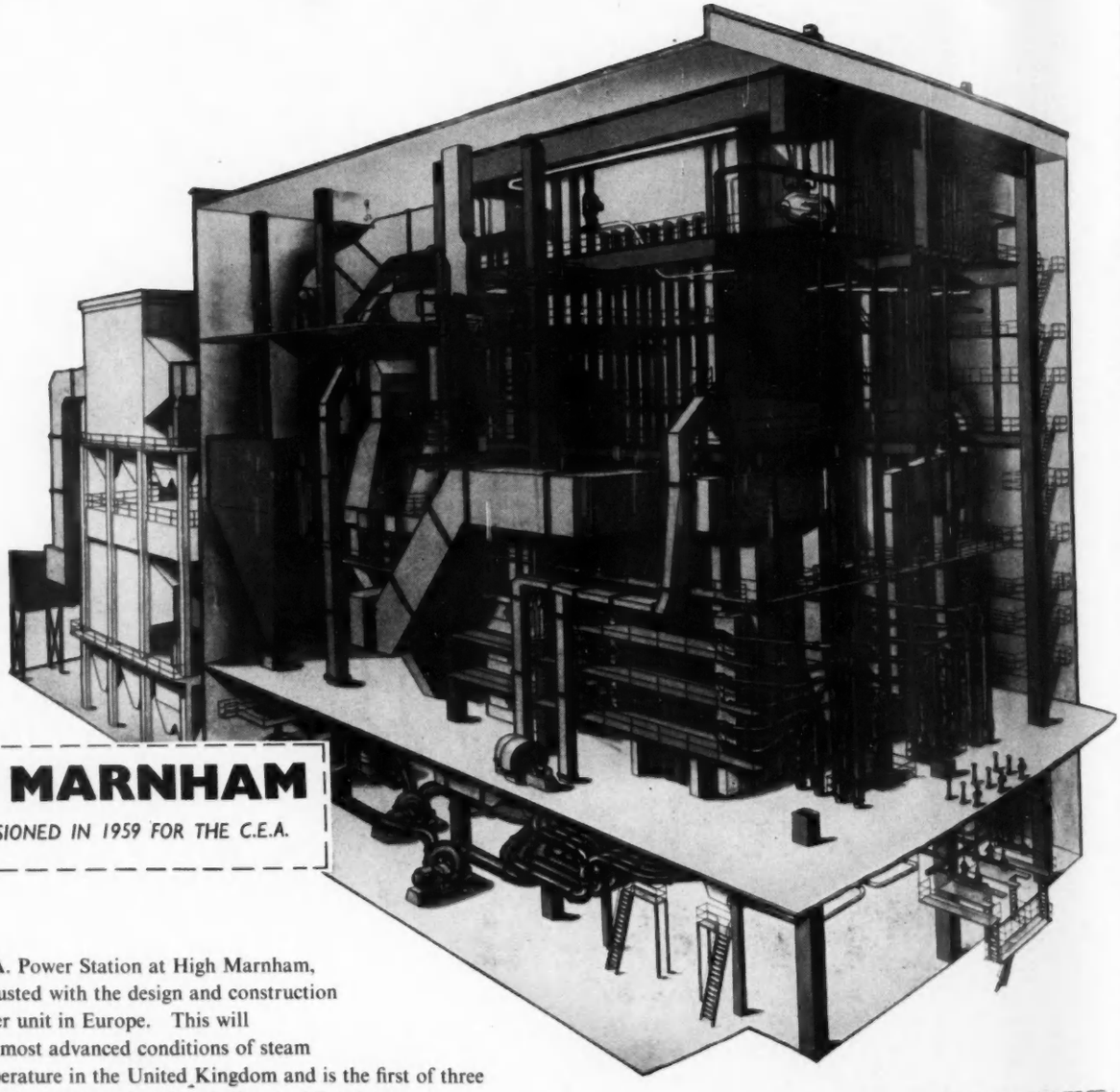

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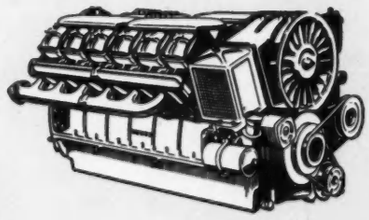

KLÖCKNER-HUMBOLDT-DEUTZ AG. KÖLN

QUALITY

This letter was recently addressed by us *to users of steel castings.* It fairly represents our views about the quality of steel castings and equally, it pinpoints the *real interests of the user.*

Manifestly, it is not the price of a steel casting in the 'as-cast' condition that really matters, it is the final cost when the casting is machined and assembled that is the *real cost* of a steel casting, and it is upon this latter cost that price comparisons should be made.

As we said in our letter, we feel sure that users will agree that this is sound commonsense, and we welcome enquiries on these terms. We make carbon steel castings up to 2 tons in weight.

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OUR REF.

Messrs. Major Wilson & Co.
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4th February, 1952

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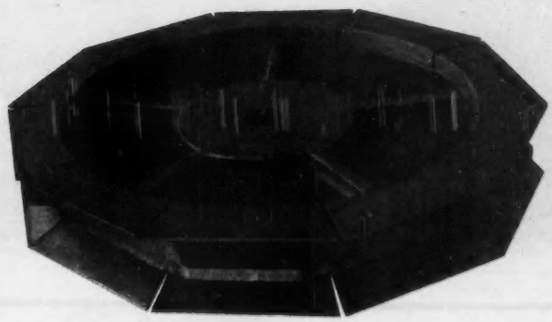
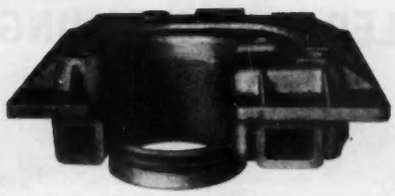
The 'price factor' as it applies to a steel casting is not a straightforward issue of how much you pay for a casting "as cast", but instead, how much does the casting finally cost when it is machined and assembled; it is that final cost we aim to reduce to a minimum.

We feel sure that you will agree that this is good sound commonsense and we should like to have your enquiries on these terms. We specialise in carbon steel castings up to 2 tons in weight.

Yours faithfully,
for BROWN, LENOX & CO. LTD.
H. A. Lenox
H. A. LENOX
Director





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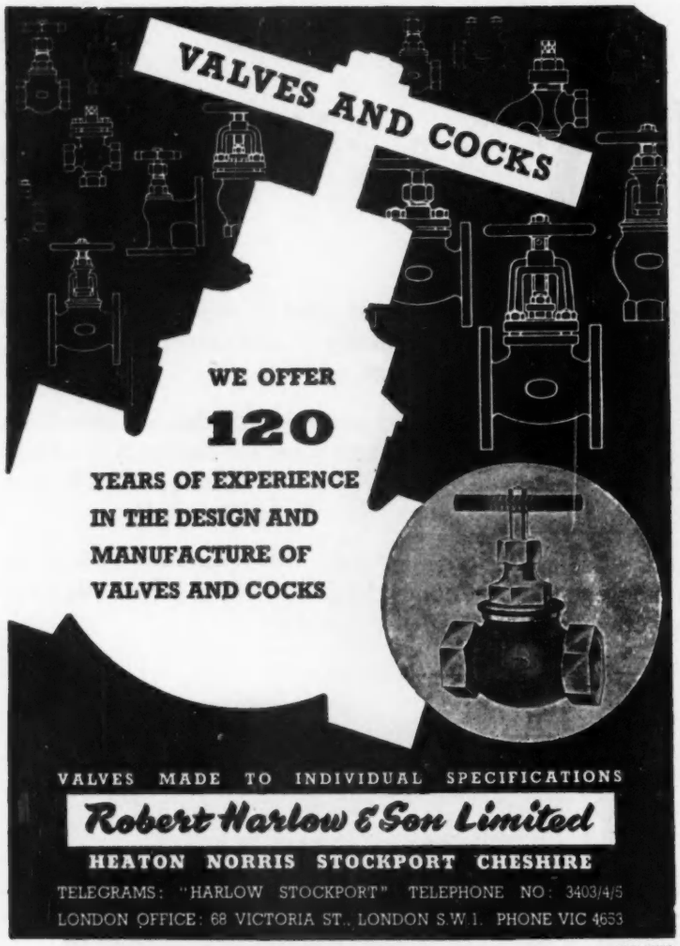

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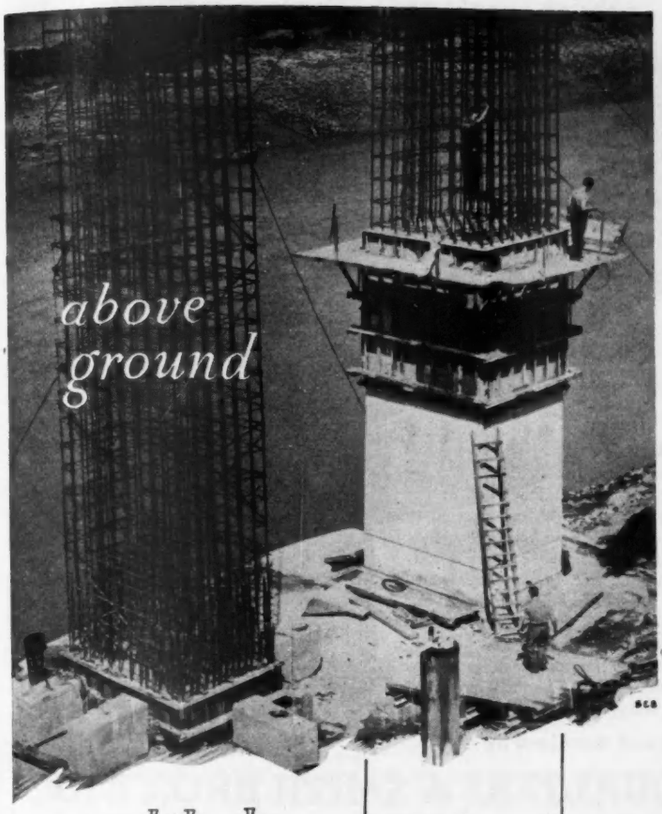

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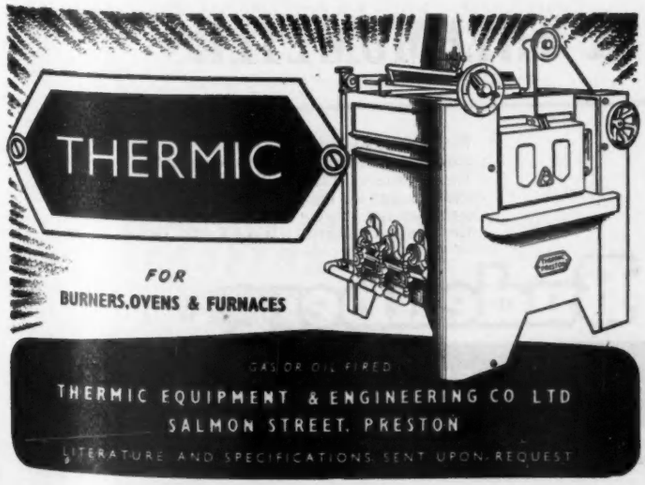

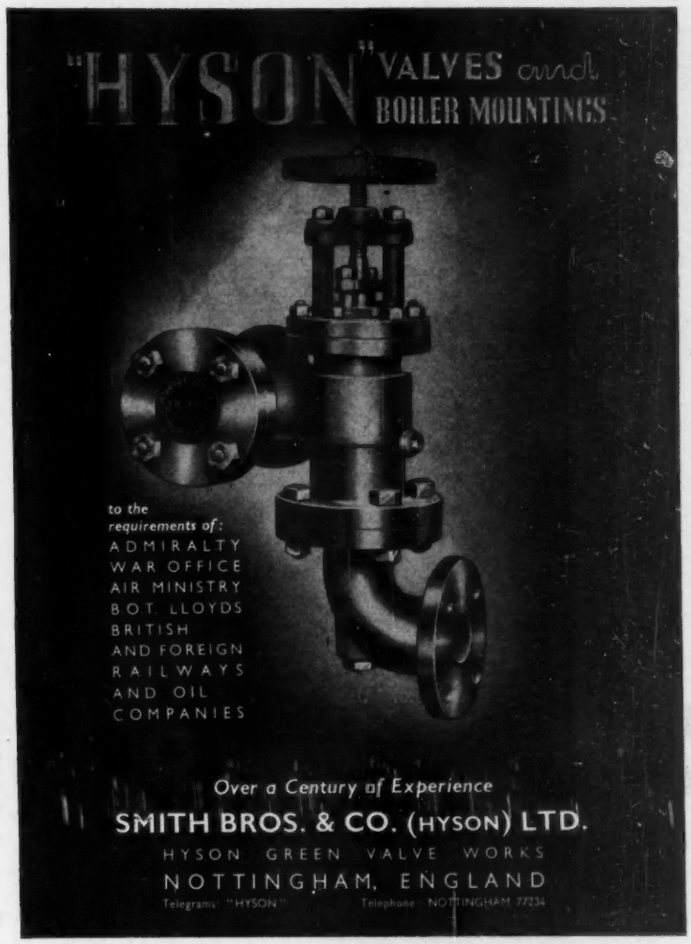

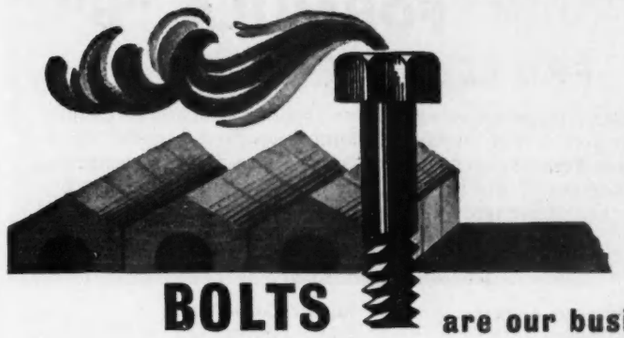

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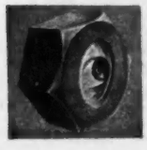

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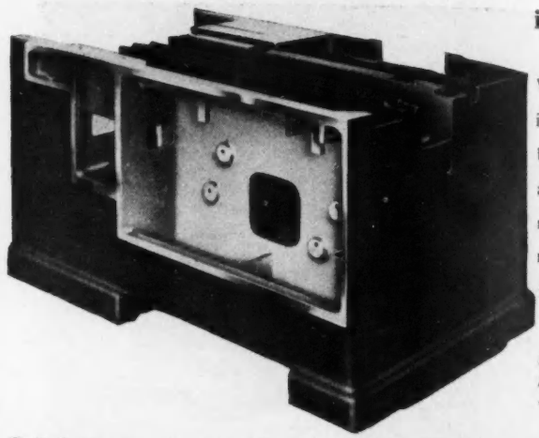

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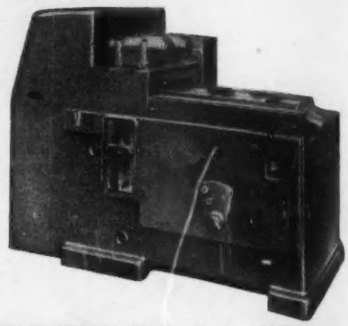

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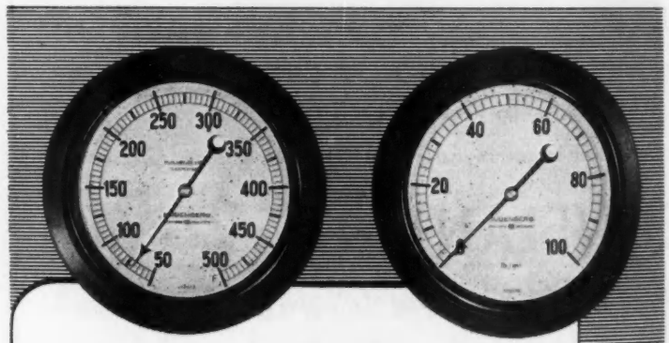

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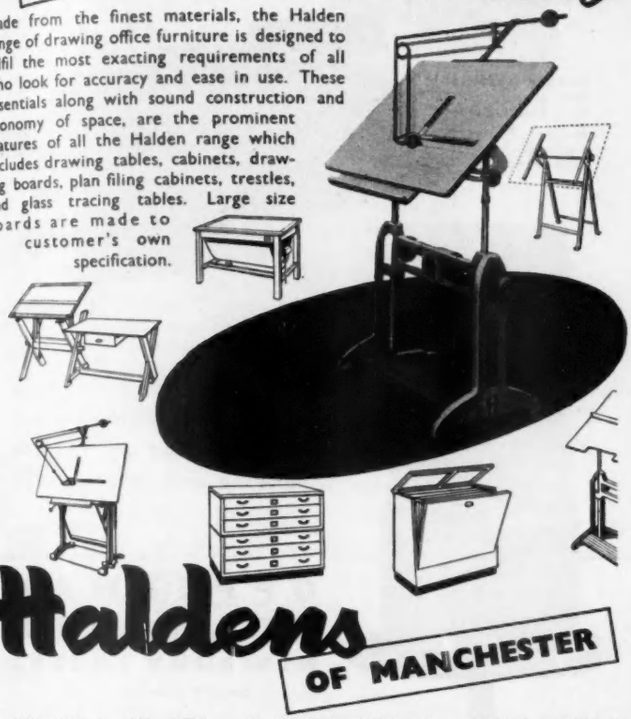

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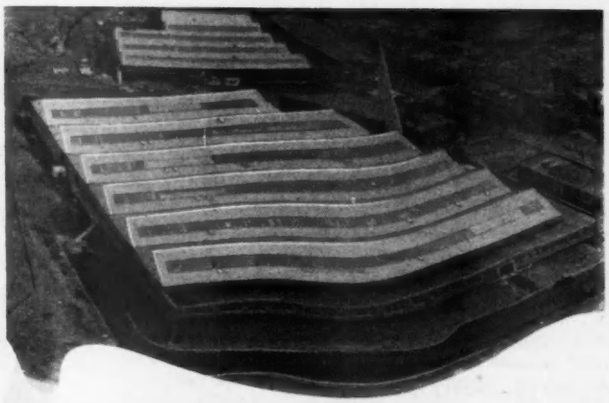

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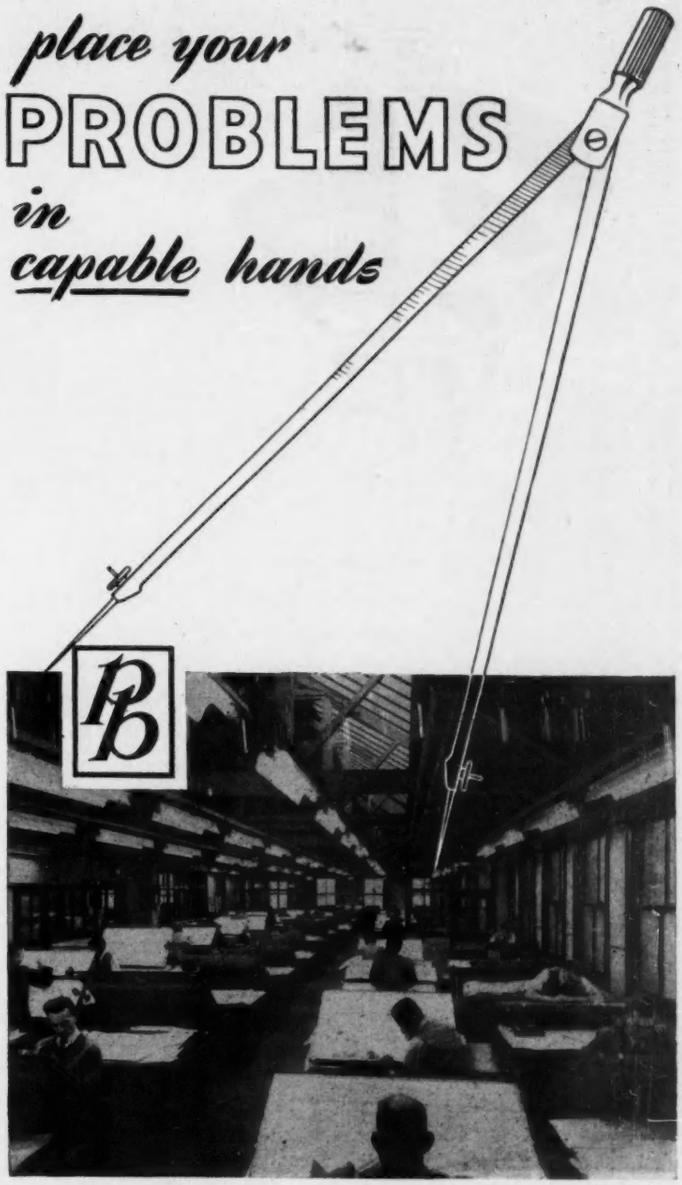

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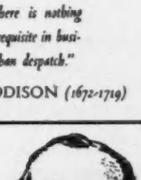

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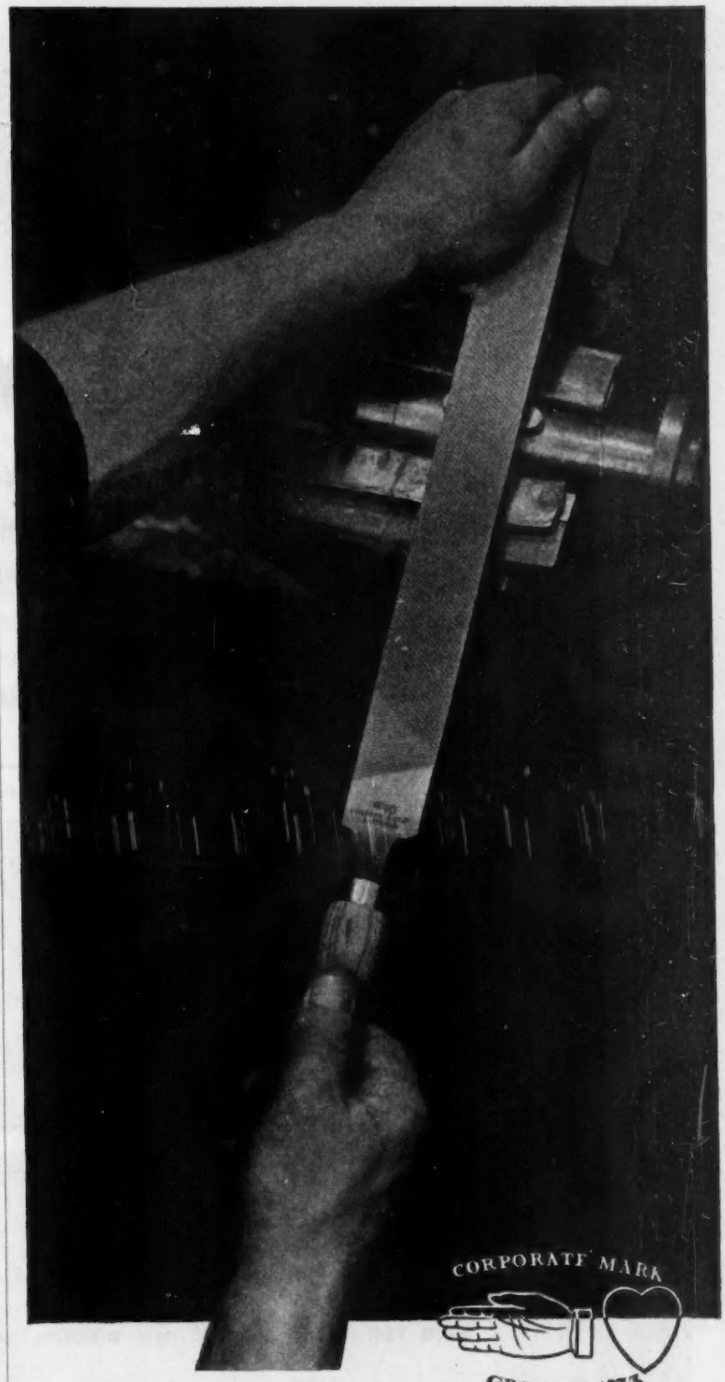

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Kaolin	12/29 ,,	30 ,,
Polyvinyl Chloride Resin ...	11/18 ,,	10 ,,
Soap Powder	19/30 ,,	70/80 ,,
Cement	14/20 ,,	20/30 ,,
Tungstic Acid	10/15 ,,	2/5 ,,
Magnesium Trisilicate	4/9 ,,	20/30 ,,

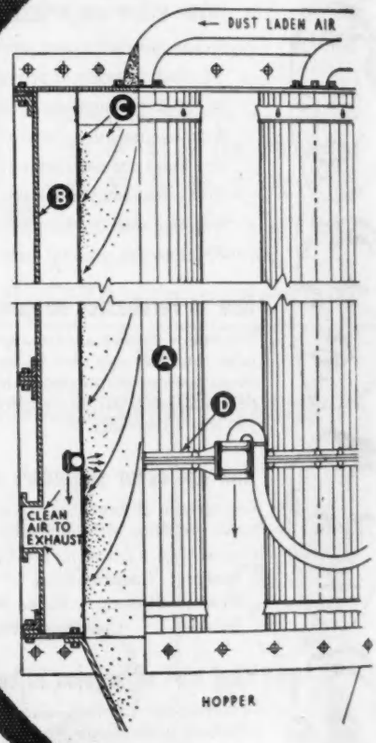

Diagram showing operation of the MIKRO-COLLECTOR—*Felt Bag (A) is clamped in housing (B). Dust-laden air enters from top (C). As the air passes through filter medium, dust deposited on inner surface of bag is dislodged by dual-action of cleaning ring (D). Cleaning is accomplished by counter-current of pressured air from ring and flexing of bag by ring as it moves up and down continuously.*

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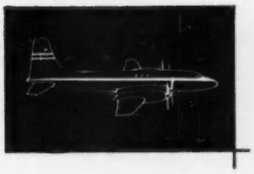
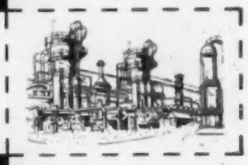
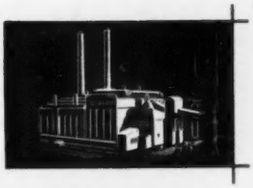

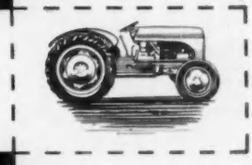
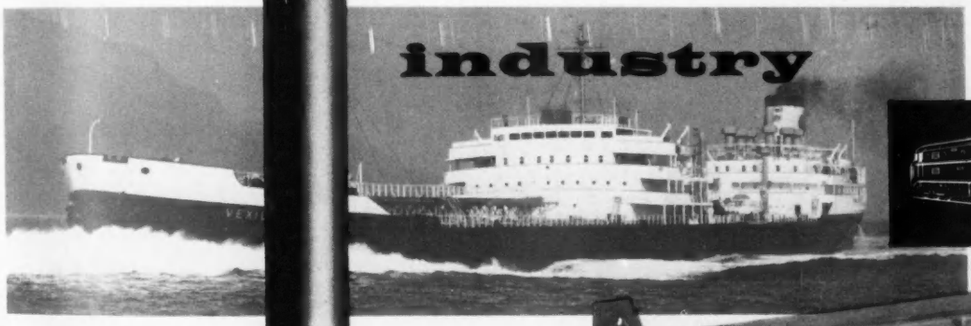

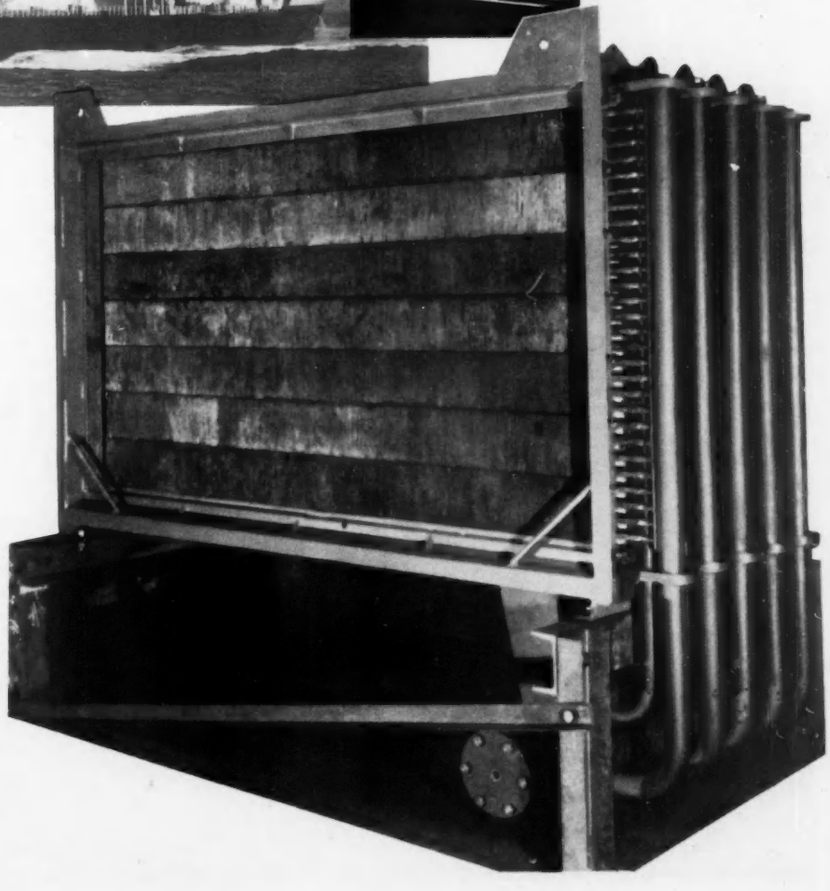

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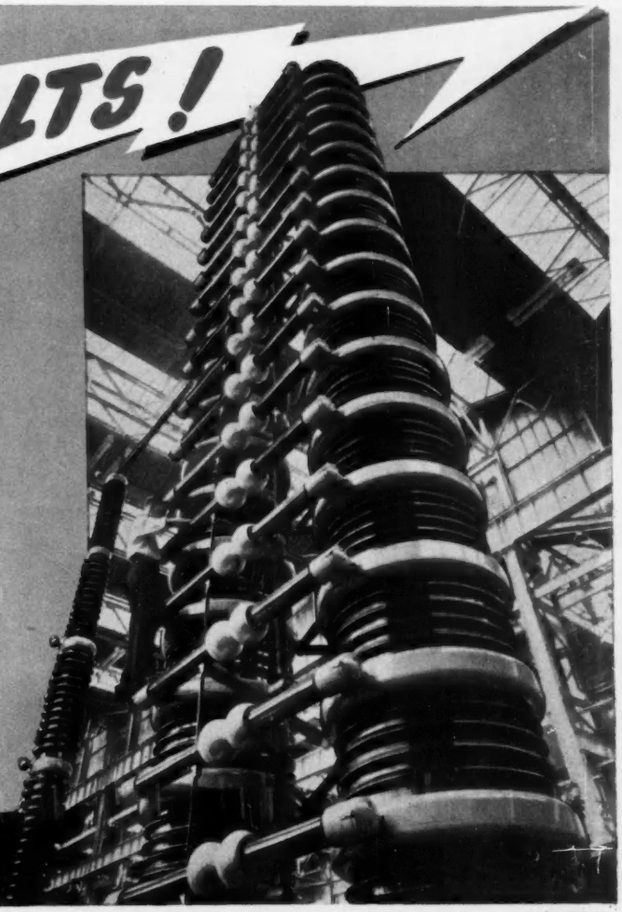

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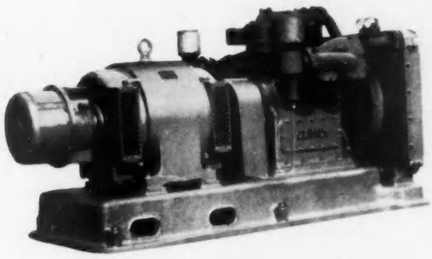

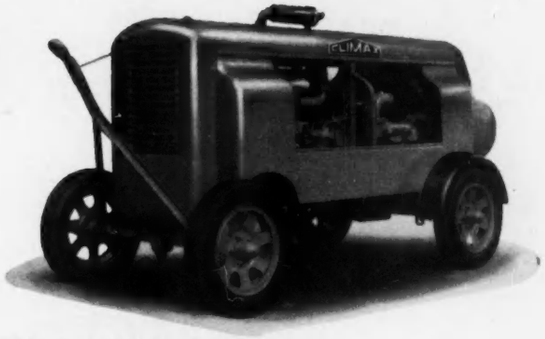

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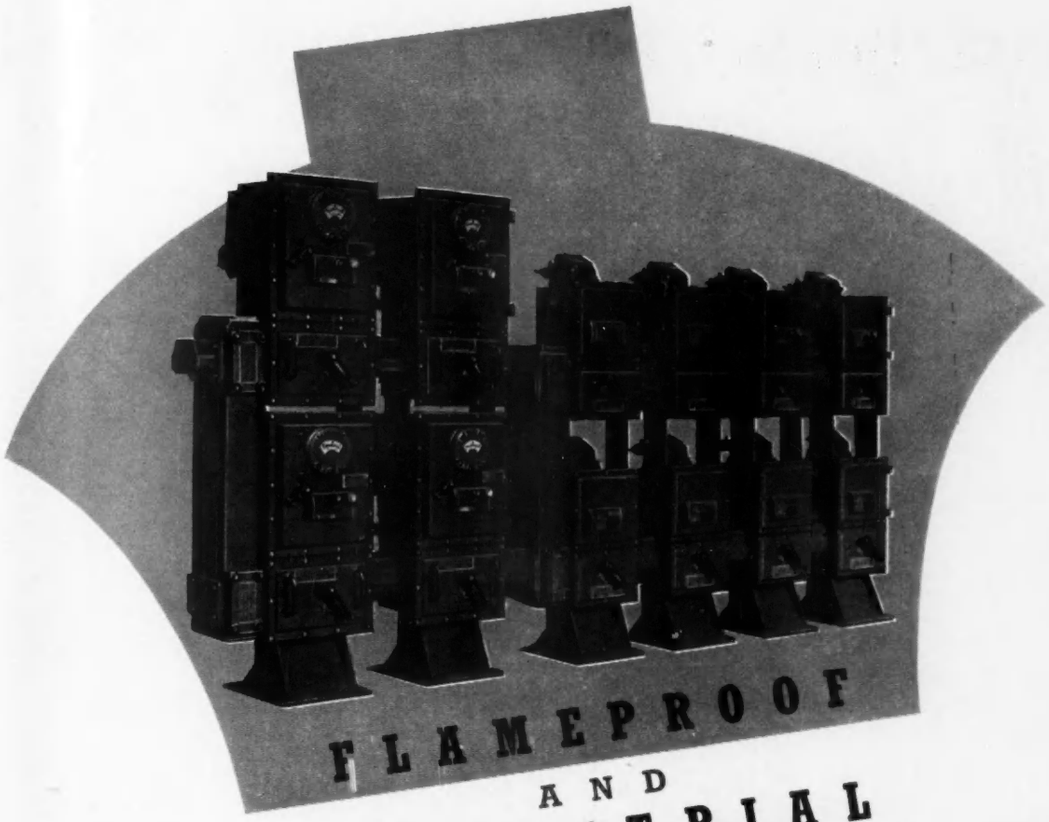

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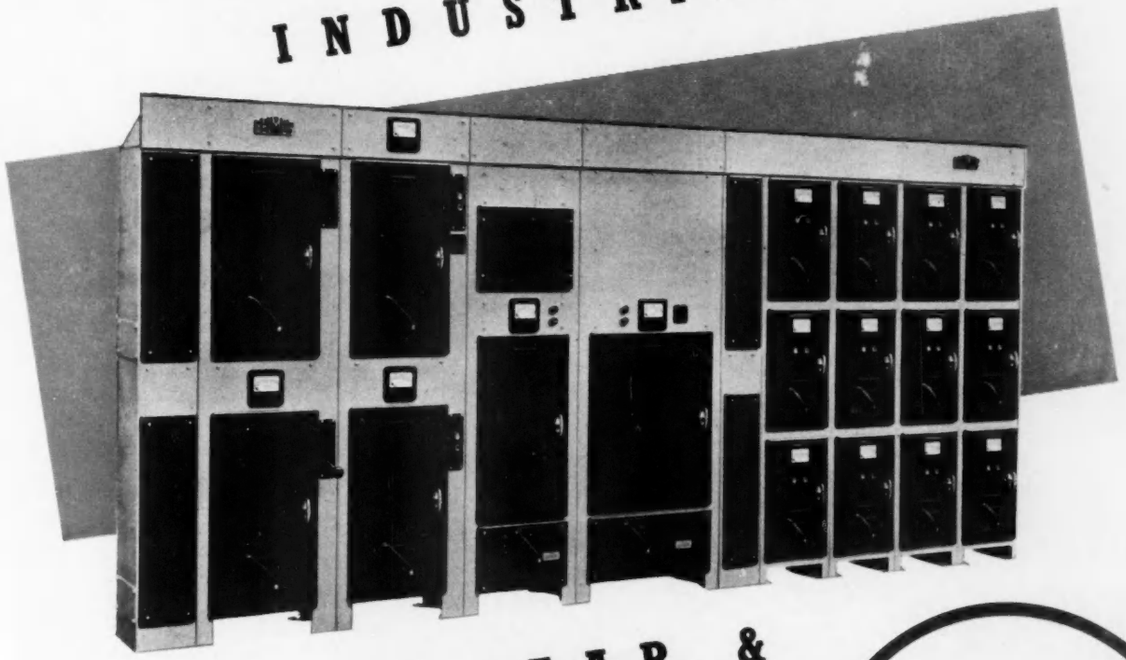

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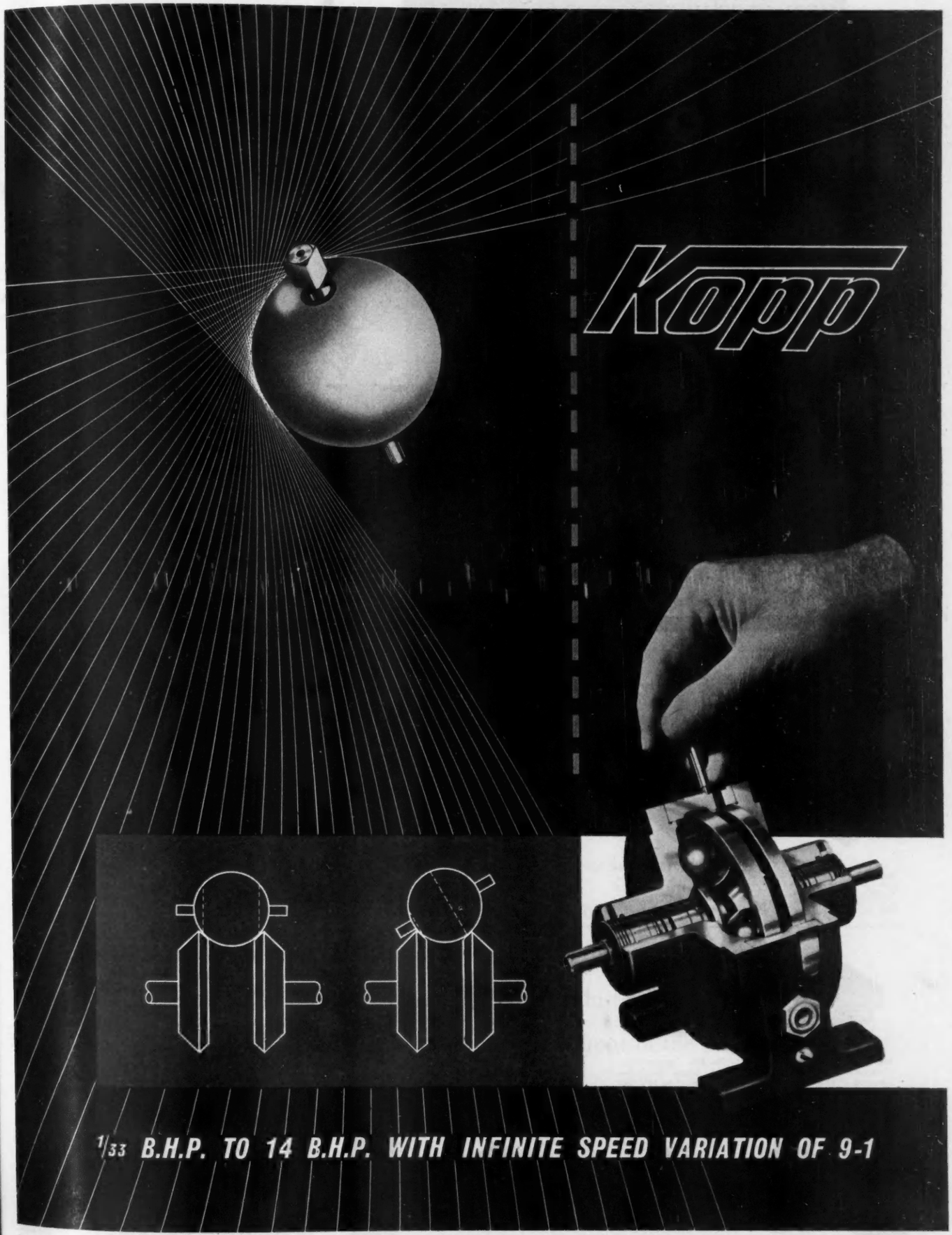

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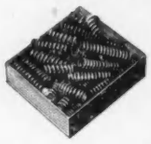

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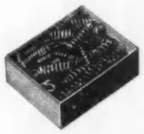

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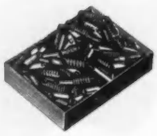

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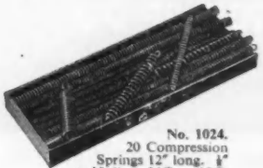

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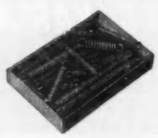

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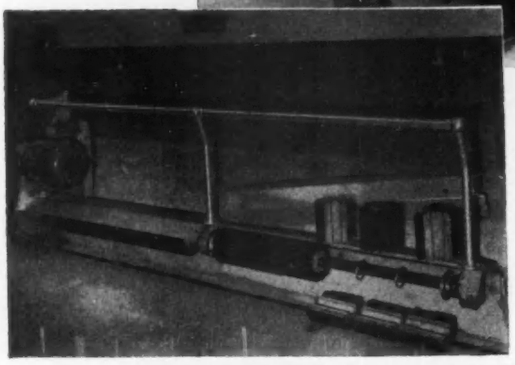

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	cu. in.	c.c.			r.p.m.	ft. in.	mm.	ft. in.	mm.
B	103	1,690	Sp. G. x 2·5	7½	710	5 0	1,524	4 0	1,218
00	263	4,310	Sp. G. x 4	10	485	8 0	2,436	4 0	1,218
1	1,140	18,700	Sp. G. x 24	40	485	13 6	4,114	7 6	2,286
3A	4,562	74,750	Sp. G. x 100	100	485	15 0	4,572	8 0	2,436
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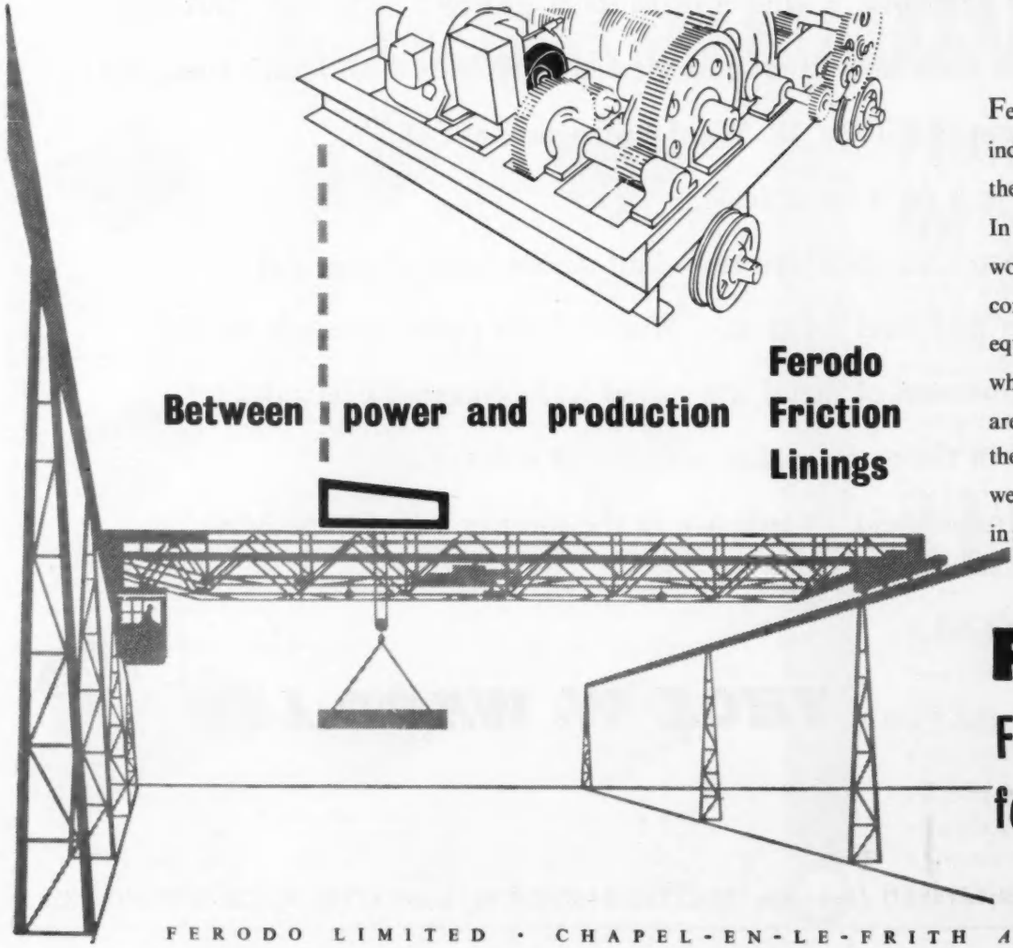

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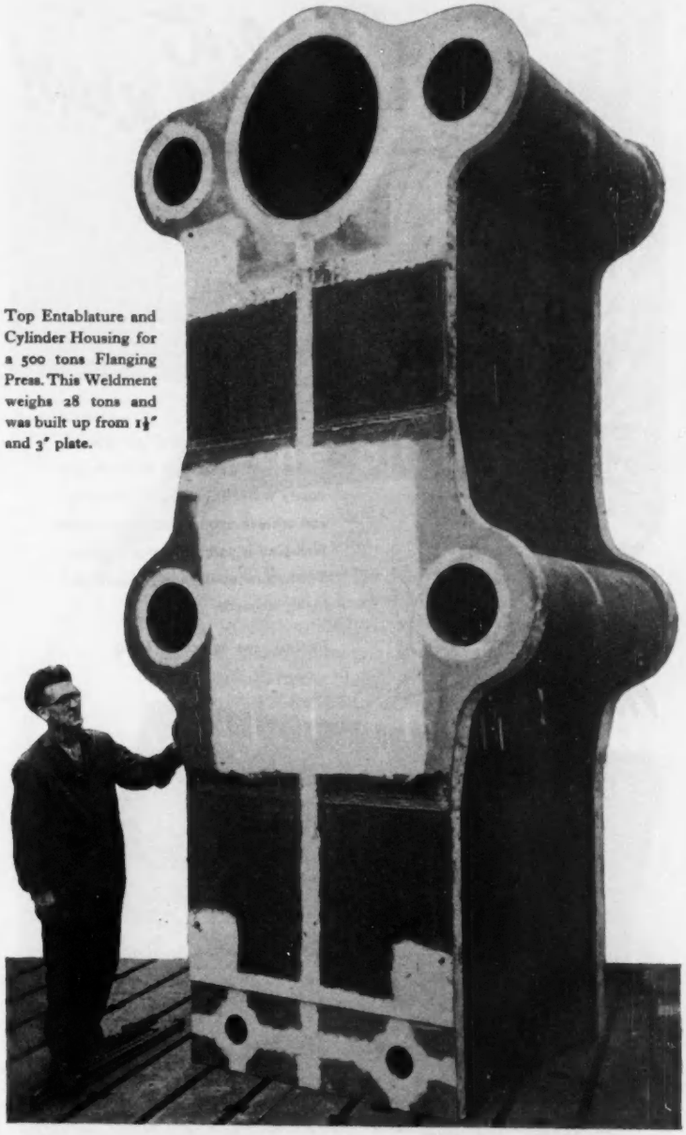

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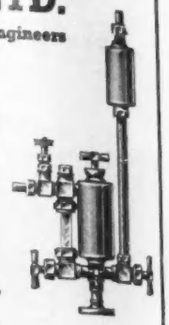

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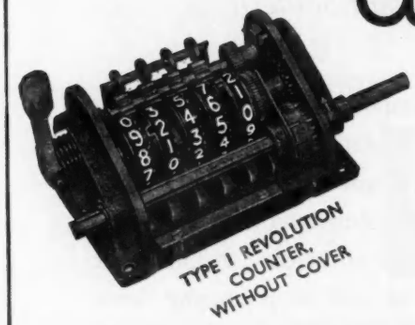

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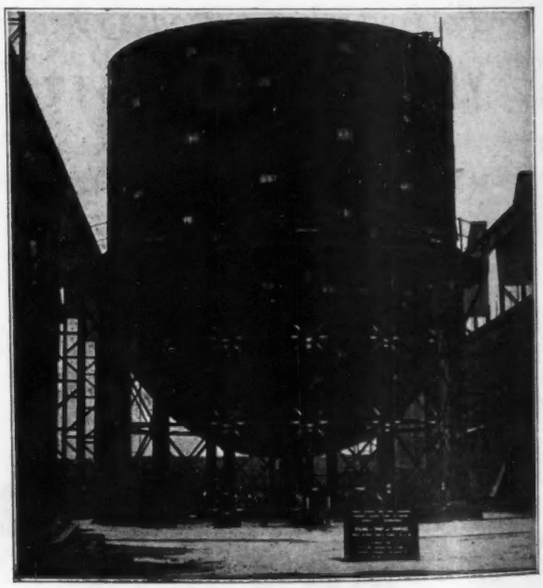

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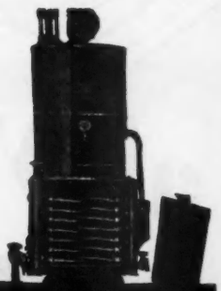

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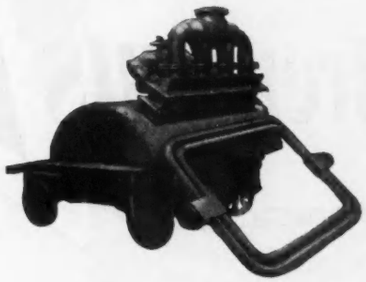

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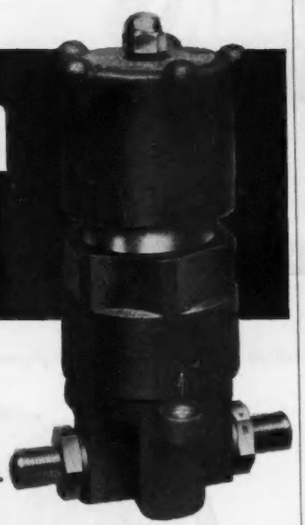

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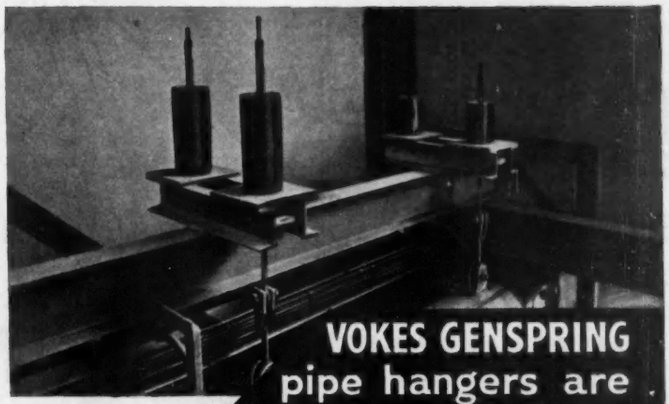

Photograph by courtesy of The Associated Ethyl Company Limited.

VOKES GENSPRING pipe hangers are used throughout the oil industry

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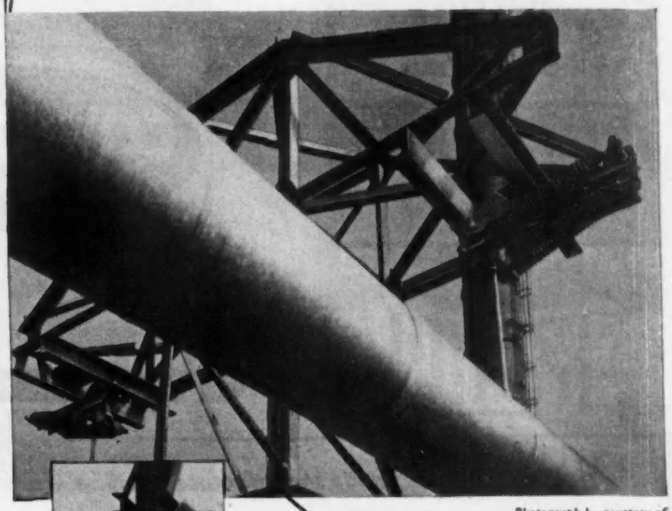

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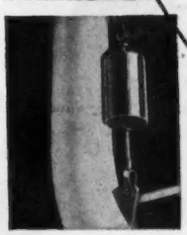

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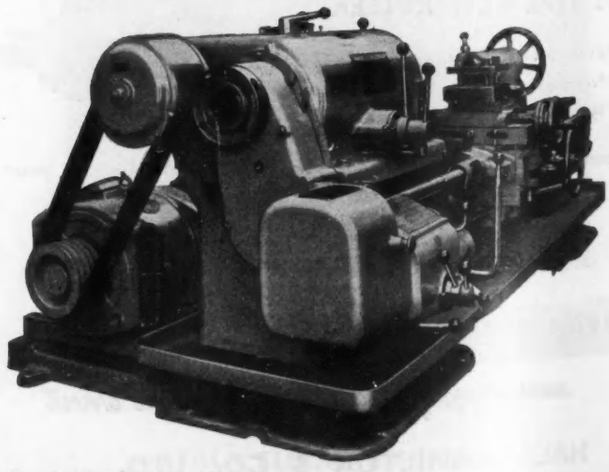

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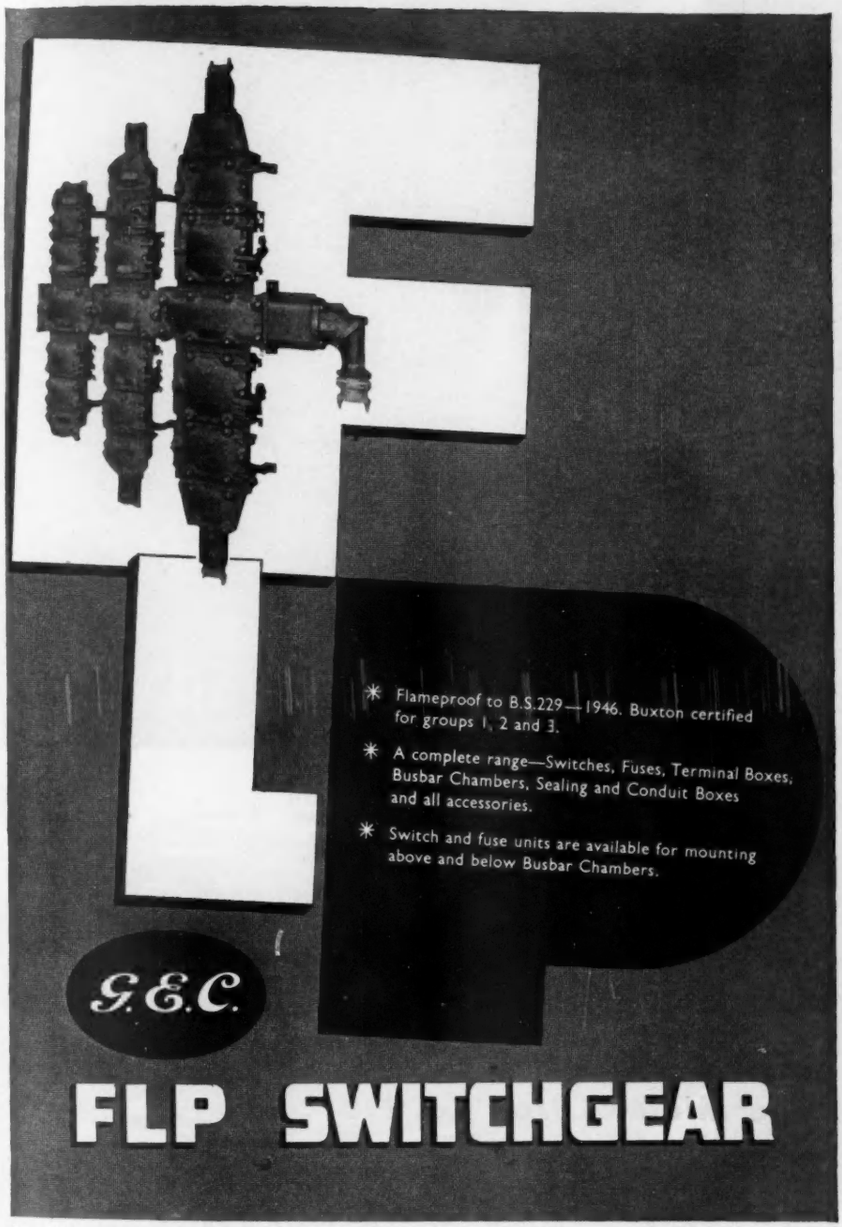
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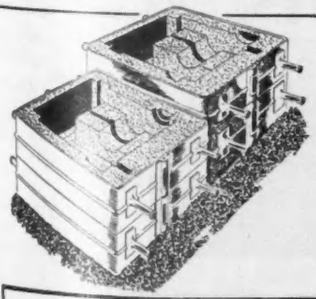

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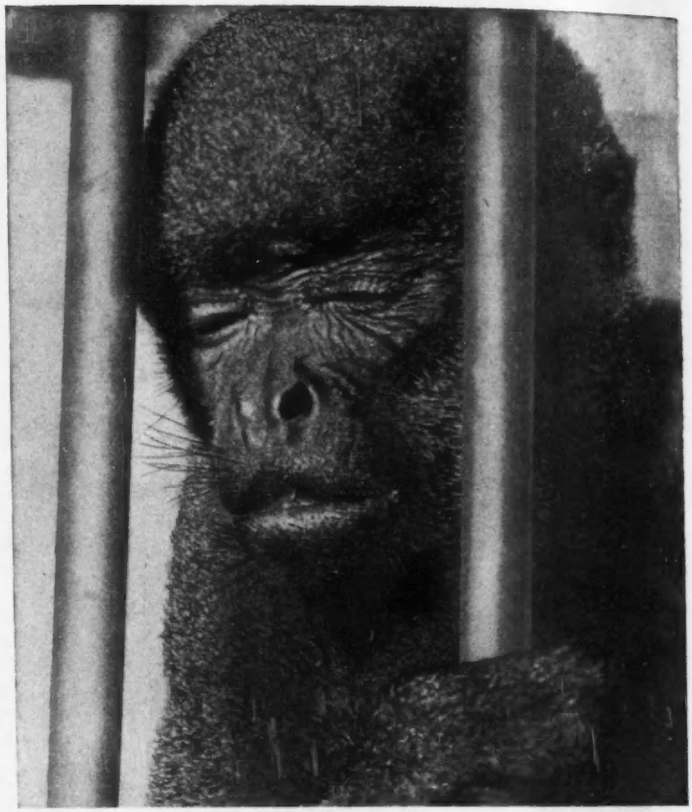

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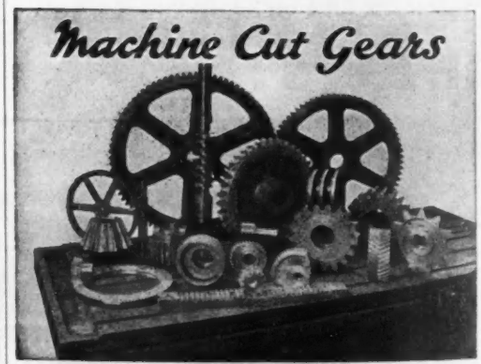

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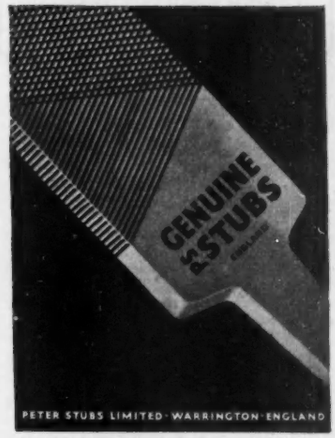

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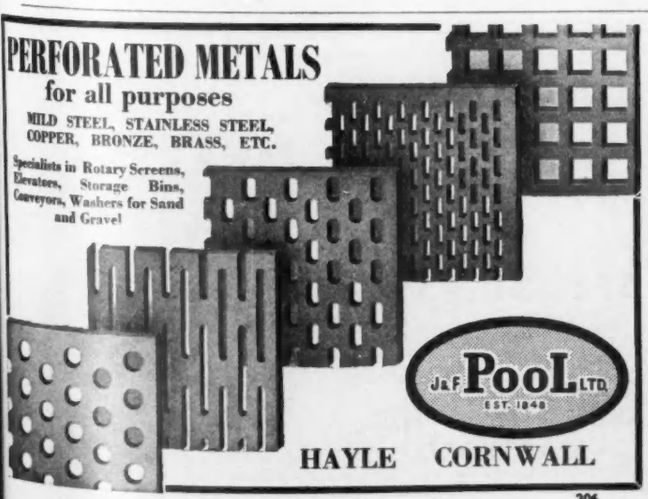

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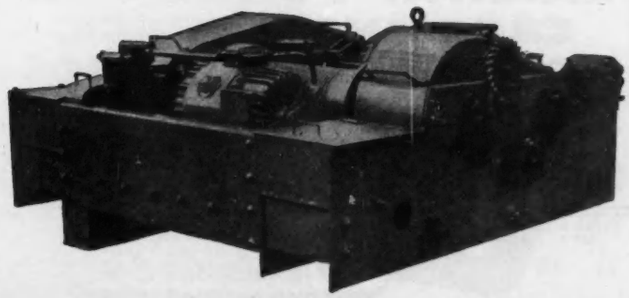

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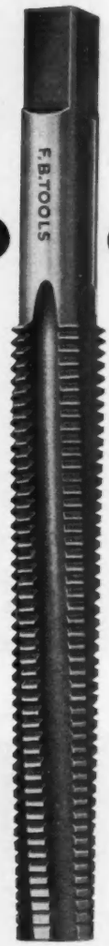

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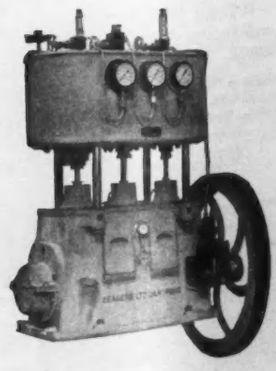

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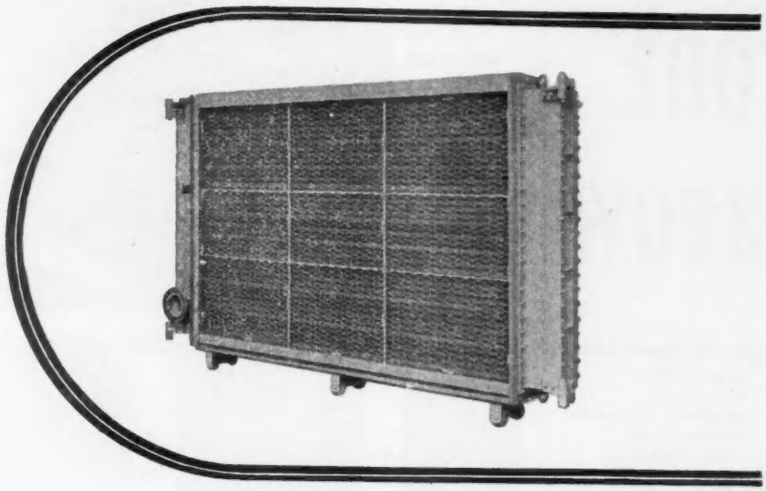

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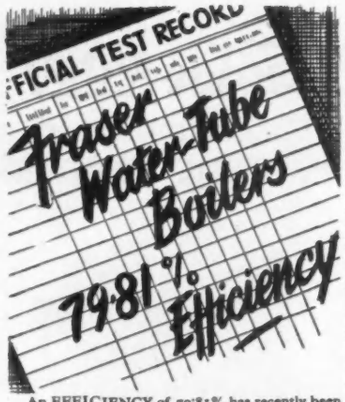

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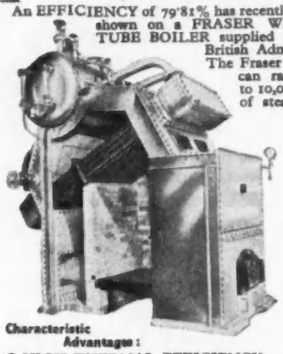

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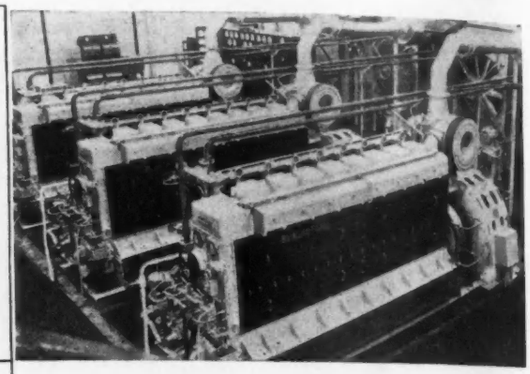

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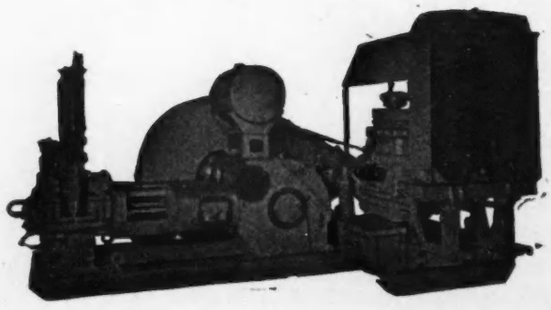

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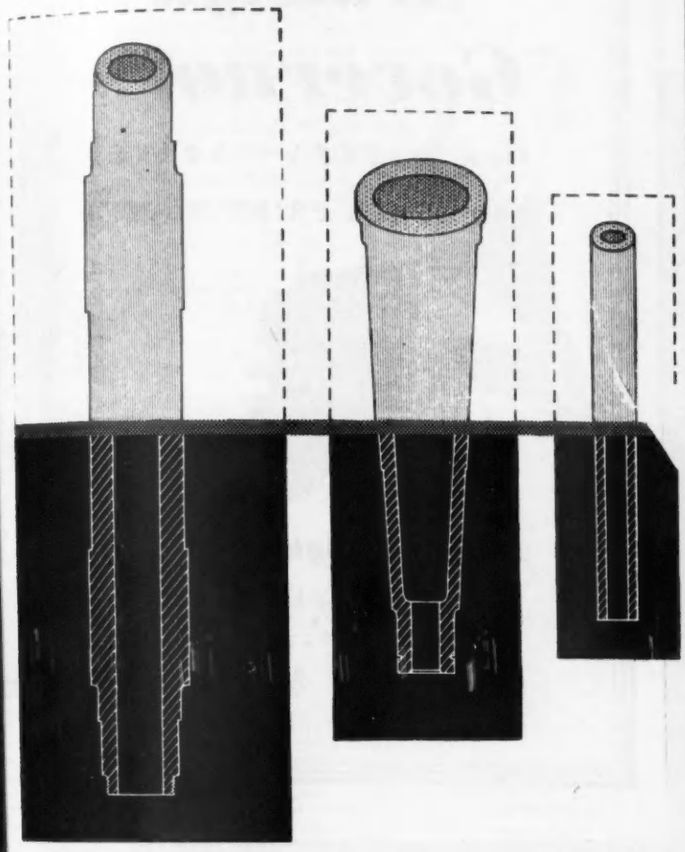

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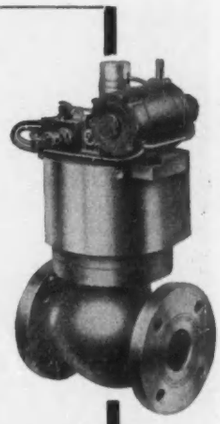

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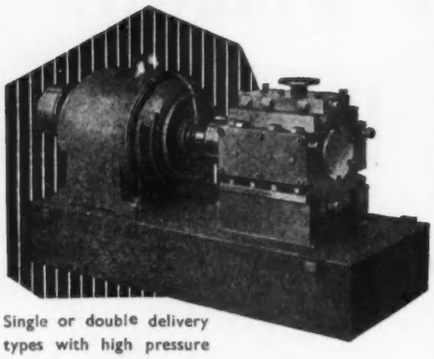

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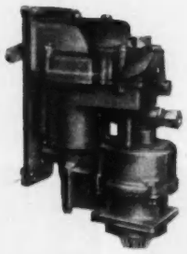

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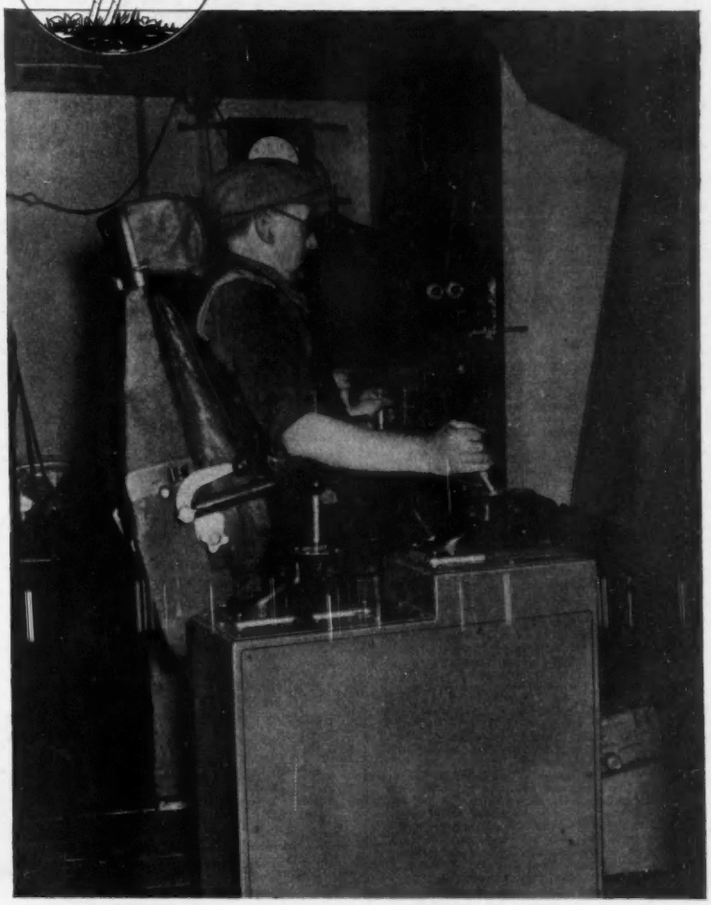

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Plant is located in North Western Pennsylvania at the centre of a resort area with ample opportunities for recreational and cultural activities and excellent educational facilities.

Generous allowance is provided to help defray travelling and shipping expenses of engineers and their dependants.

To arrange for an interview, send IMMEDIATELY résumé of education and experience and your telephone number to "N.F.S.," McCann-Erickson Advertising Ltd., Brettenham House, Lancaster Place, W.C.2. Interviews will be arranged in London. M 29

A. REYROLLE & CO., LTD., OF HEBBURN-CO. DURHAM, who are the largest firm of switch, gear specialists in the world, have vacancies for **CONTRACTS ENGINEERS**, both for home and overseas contracts work on E.H.V. and H.V. switchgear. The appointment would be for work at Hebburn, and it is customary for the Company to appoint engineers for duties in the overseas and home area offices from engineers trained at Hebburn. The work requires initiative and affords the engineer individual responsibility. It is interesting and varied and calls for ability to conduct both technical and commercial negotiations. The desirable qualifications are therefore a Degree or a Higher National Diploma or Higher National Certificate, but candidates having an Ordinary National Certificate who are still proceeding with studies could be considered specially. Applicants need not have specialised previously in switchgear, and, if necessary, suitable introductory training would be arranged. Applications, giving full particulars of technical training and previous experience, should be forwarded to the CONTRACTS MANAGER, A. REYROLLE AND CO., LTD., HEBBURN, CO. DURHAM, marked "PERSONAL." L 892

CHIEF STEAM AND POWER ENGINEER required for large new pulp and paper mill in New Zealand. Applicants must have engineering degree or equivalent qualification plus sound practical experience of boiler and power plant design and operation. Successful candidate will be required to control efficient operation and maintenance of 2—150,000 lb./hr. coal fired boilers, 1—90,000 lb./hr. Black Liquor Boiler, also 1—15 MW Pass-out Turbine. He will also be responsible for all future developments of Steam and Power Plant which includes the utilization of geothermal steam. A house to rent will be provided and all expenses to New Zealand paid including those of his family. Applicants must apply in writing giving full details of experience, qualifications, to CHIEF ENGINEER, ALBERT E. REED & CO., LTD., GROUP ENGINEERING DIVISION, LARKFIELD, NR. MAIDSTONE, KENT. L 966

SERVICES ENGINEER.

B.X. PLASTICS, LTD., BRANTHAM WORKS, NR. MANNINGTREE, ESSEX, require a Services Engineer with wide experience for the Brantham factory. Applications are invited from men with good experience in power generation, steam and electrical distribution, building work, and hydraulics. Age: between 30 and 35. Salary by arrangement. Applications which will be treated in confidence should give previous experience and qualifications, and be addressed to the PERSONNEL MANAGER AT BRANTHAM WORKS. M 44

SCHLUMBERGER.

Invite applications for

GEOPHYSICAL AND PRODUCTION WORK IN OILFIELDS in many parts of the world. Candidates should hold a University degree (preferably with Honours) in Electrical and/or Mechanical Engineering. Knowledge of Electronics is an asset. Candidates should be free of military obligations. Training is done abroad on bachelor status but thereafter living conditions are also favourable to married men. The age limit is 30 years.

Applications and enquiries should be addressed to:—

SCHLUMBERGER OVERSEAS,
42, RUE ST.-DOMINIQUE,
PARIS 7e—FRANCE.
To the attention of J. L. Mathieu. M 57

BRITISH INSULATED CALLENDER'S CABLES LTD., require

A GRADUATE MECHANICAL ENGINEER with practical experience of Rubber and/or Plastic moulding and jig and tool designing and manufacture. The appointed candidate would initially be employed with a Work(Study Unit concentrating on production techniques in an expanding Rubber and Plastic Moulding Department with an early opportunity for a man with the ability and personality to transfer to an executive position. Applications quoting Reference A/40/56, should be addressed to the STAFF OFFICER, B.I.C.C. LTD., PRESCOT, LANCS. M 11

TRANSFORMER SPECIALIST ENGINEER required for a Senior Sales Post in a progressive Company. The man appointed should possess at least an H.N.C. (Electrical) and preferably be a corporate member of the I.E.E. He should have recent experience on the design of transformers up to 45 mVA, 132 kV and possess the qualities of personality necessary in a first class sales engineer. For the right man there are excellent prospects of promotion to top Management positions in an expanding organisation. Terms of employment include staff bonus and generous non-contributory superannuation. Please apply to the CHIEF PERSONNEL OFFICER, BRUSH ELECTRICAL ENGINEERING CO., LTD., LOUGHBOROUGH, LEICS. M 15

There is an opportunity for a
DEVELOPMENT ENGINEER AND DRAUGHTSMAN who seeks an interesting and varied career to join the staff of a leading industrial organisation. Experience is required in design of special purpose machine tools, layout of services, handling of plant engaged on large and small pressed steel components.

Ability to follow a job through to completion is required. Education to H.N.C. or equivalent is preferred.

Pension and Sickness insurance Schemes and Canteen facilities are available.

Application should include details of age, experience and salary required to:—CHIEF ENGINEER, JOHN THOMPSON MOTOR PRESSINGS, LIMITED, WOLVERHAMPTON. M 40

DRAUGHTSMEN required in various drawing offices at Fort Dunlop. There are exceptionally good opportunities for draughtsmen interested in plant layout (including services), special purpose machine design, and tyre design. Promotion comes swiftly to keen and efficient men. There is a good pension scheme. Please write, giving age, experience and salary required, to PERSONNEL MANAGER (M.16), DUNLOP RUBBER CO., LTD., FORT DUNLOP, ERDINGTON, BIRMINGHAM, 24. G 667

THE
GLACIER METAL CO. LTD.
Ealing Road, Alperton, Wembley, Middlesex

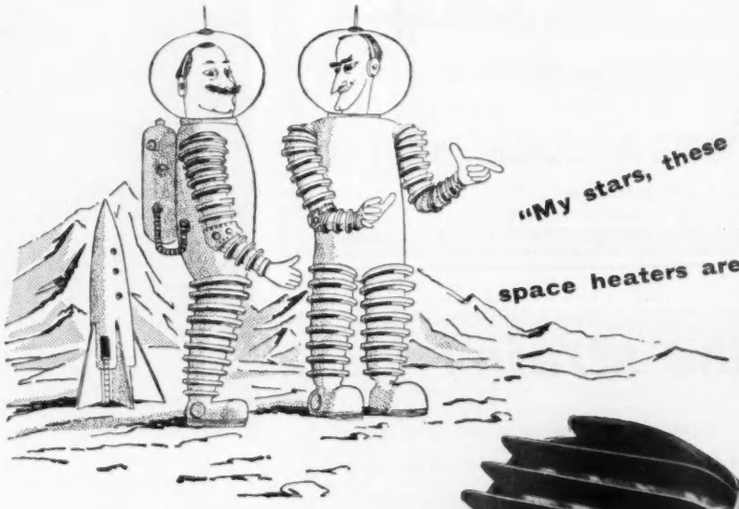
Applications are invited for the job of

TOOLROOM MANAGER
LONDON FACTORY

directly responsible to the General Manager for the manufacture of job tools and machine tools. Full responsibility for programming work and costs of a department of approx. 100 personnel. High degree of technical ability plus the managerial maturity to lead his organisation are essential.

Desirable age range 30/45
Salary range £1500 to £2000

Written applications to Personnel Director at the above address. M 49



That may be looking a little ahead. But here and now G.E.C. space heaters are the best way to provide touch-of-the-switch heating wherever you want it, whenever you want it. Look at the advantages. They're so easy to install. You can fix them to walls, or suspend them wherever needed. They require no maintenance. You don't need stokers—a big point in the present labour shortage. They don't make any fumes or dirt so you save on cleaning and on decorating. See about fitting your G.E.C. space heaters now. This constant source of dispersed heat is excellent for large offices, reception rooms, cloak rooms, dining halls, rest rooms. In fact, any large enclosed space where touch-of-the-switch heating would be welcome is a place for G.E.C. space heaters.

G.E.C.

3 kW & 5, 10, 15 and 20 kW
ELECTRIC UNIT HEATERS

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

"IMPOSSIBLE" TASK COMPLETED ON TIME!

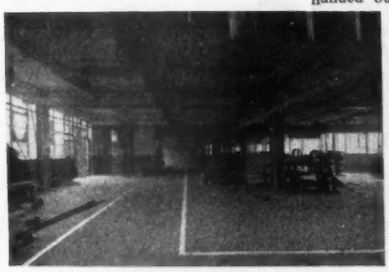
Wards do it again! Over 1200 tons of machinery lifted, re-sited and re-wired in 16 days without loss of production

"Move 1,200 tons of machinery and stores into a new extension in the 16-day holiday period so that no production time is lost."

That was the assignment given to Thos. W. Ward Ltd., of Sheffield, by Stanley Works (Great Britain) Ltd., of Sheffield, recently. Many people thought that this was an impossible task, but it was carried out successfully by Ward's Factory Planning and Installation Department.

The new extension at the rear of the existing factory consists of three floors each 200ft. long, and a sub-basement, and it was appreciated by Stanleys that to equip the extension in the normal manner would involve a serious dislocation of production.

On consultation with Wards it was decided to carry out the new move during the annual works holiday period from July 24th to August 9th, and on the morning of July 24th, 200 of Ward's men, comprising builders, painters, millwrights, electricians and machine erectors, took over.



The plane department before the move.

This was no ordinary operation. During the first four days the entire plane shop had to be moved one floor down and resited in order to give the electricians a good start with their rewiring programme, and to leave the civil contractors a clear 10 to 11 days in which to rebuild a block of offices in the old plane shop. At the same time, on the ground floor, in an entirely different part of the building, 160 tons of finished planes, screwdrivers and similar tools, in cardboard boxes, had to be moved into a new warehouse.

At work again after the holiday.

The next move was to re-organise the existing supply stores. All these thousands of different items had to be manhandled in a confined space and replaced on the new site in the same bins, so as to be ready to be handed out at 8 o'clock on Monday, August 9th. At the same time, large Snow grinders were being resited into the new building on the ground floor, complete with their part-finished products. The entire glazing shop, complete with extractor trunking and part-finished materials, was then moved from the fourth floor to the ground floor. A finishing shop was moved one floor up, which involved the removal of a cyclone from the roof of the old building to the new roof. This was carried out during a gale. In addition, the works maintenance shop was transferred to a new location in four hours, so that this vital link in the operations was constantly available.

Every machine tool moved was accompanied by its partly finished products so that production could re-commence without delay when the operators returned to work. This involved careful marking of boxes in the removal.

In the 16 days, 238 machines, ranging in weight from 35 cwts. to 12 tons and totalling about 1,200 tons, were lifted, re-sited and re-wired. Most of the machines were moved in one piece, and only in the case of the heaviest machines was it necessary to dismantle partly. Work continued through weekends and Bank Holiday, and by Sunday, August 8th, the job was completed according to schedule.

Thos. W. Ward Ltd

FACTORY PLANNING & INSTALLATION DEPARTMENT

ANOTHER TWW ACTIVITY

ALBION WORKS · SHEFFIELD · Phone: 26311 (22 lines) · 'Grams: Forward Sheffield

and Brettenham House, Lancaster Place, Strand, W.C.2.

F.P.I.15

OIL AND CHEMICAL PLANT CONSTRUCTION PROJECT

MANAGERS AND SUPERVISORS

REQUIRED FOR WORK IN MIDDLE EAST, FAR EAST AND UNITED KINGDOM.

Vacancies exist for

MANAGERS and **SUPERVISORY ENGINEERS** capable of taking charge of field project organisations varying from a single plant or unit to projects comprising complete refineries with field forces consisting of upwards of 150 staff and 3,000 men. Applicants must have held responsible positions in similar capacity and must have some years of experience in field construction of oil or chemical plants. Chief qualifications required are good organising and administrative ability, with sound knowledge of the following branches of engineering activity:—Drafting, Civil, Mechanical, Electrical, Welding, Vessels and Piping. Field Office organisation covering staff, labour, costs and materials. Top age-limit for work outside U.K. is 55 years. Applicants must be physically fit and prepared to reside at site of work with or without family for periods varying from 6 months to 2 to 3 years, according to the magnitude and location of the project. Salary and allowances will be substantial and commensurate with experience and ability of applicants.

Top men only need apply. Applications, giving details of past experience and positions held, should be marked "Confidential" and will be treated accordingly.

CONSTRUCTION MANAGER (PROCESS PLANTS), FOSTER WHEELER, LIMITED, 3, IXWORTH PLACE, LONDON, S.W.3. M 5

Foundry Plant manufacturerers in the Birmingham area require

SENIOR DRAUGHTSMAN with mechanical handling and/or structural experience for highly mechanised cupola melting plants. Full details in confidence to:—PERSONNEL MANAGER, INCANDESCENT HEAT CO., LTD., CORNWALL ROAD, SMETHWICK. M 24

IMPERIAL CHEMICAL INDUSTRIES LIMITED, METALS DIVISION. There is a vacancy in the Ammunition Department for a

DESIGN DRAUGHTSMAN for plant and tool design and development connected with the production of small arms ammunition. Applicants, preferably in the age range 23-30, should possess a Higher National Certificate in mechanical engineering, or its equivalent. Experience of mass production methods is essential. Excellent conditions of employment include a generous starting salary for a five-day week, Pension Fund and Profit Sharing Scheme. Applications should be addressed to the STAFF MANAGER, IMPERIAL CHEMICAL INDUSTRIES LIMITED, (METALS DIVISION), KYNOCH WORKS, WITTON, BIRMINGHAM, 6, quoting AD/3/ENG. M 100

WORKS MANAGER required by medium sized engineering firm in North East manufacturing products of international repute. Must be capable of instituting works organization and controlling development and expansion. This position is permanent and progressive.—Write giving full particulars in confidence to BOX M 102, Offices of ENGINEERING.

OUTSTANDING OPPORTUNITY OFFERED BY A RAPIDLY EXPANDING COMPANY.

We are looking for a

PRODUCTION MANAGER having a wide practical experience of control of purchasing, planning, and manufacturing techniques, preferably in the light engineering industry. Engineering degree desirable. This is a senior executive post with excellent prospects for suitable applicant. Contributory Pension Scheme.—Write fully to BOX M 89, Offices of ENGINEERING.

Classified Advertisements continued on Page 148

STEAM METERS AND INDICATORS

- SAVE FUEL
- SHOW TRUE BOILER OUTPUT
- MAY ALSO BE USED AS A PORTABLE TEST METER

Write for illustrated booklet.

CURNON ENGINEERING CO.

TELE. CHOrlton 3885

CLAUDE ROAD WORKS, CHORLTON, MANCHESTER, 21

GREY IRON

CASTINGS

ANY WEIGHT UP TO 100 TONS

SPHEROIDAL GRAPHITE CAST IRON
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HARLAND & WOLFF LIMITED

CLYDE FOUNDRY, GOVAN, GLASGOW

TELEGRAMS CLYFOUNDIC GLASGOW TELEPHONE GOVAN 2266

ENGINEER/DESIGN DRAUGHTSMAN required possessing initiative, sound engineering training, preferably with workshop experience and a minimum qualification of H.N.C. or equivalent. Duties will include preparation of drawings, estimates, calculations and the handling of correspondence associated with the design and layout of Steelworks Plant, buildings and hydraulic installations. Vacancy which exists in the Sheffield area presents a first-class opportunity to join a large Organization who offer good salary and excellent prospects to successful applicant. Superannuation Scheme, dining and sports club facilities available. Written applications giving details of age, education and practical experience to be forwarded to BOX M 38, Offices of ENGINEERING.

DRAUGHTSMAN required for Engine Design Schemes on small high-speed diesels must have initiative and experience. Good salary. Pleasant working conditions. Pension Scheme.—Apply CHIEF PERSONNEL OFFICER, PETTERS LIMITED, CAUSEWAY WORKS, STAINES. G 650

BRITISH PETROLEUM COMPANY LIMITED has vacancies for

ENGINEERS for training as Plant Inspectors at their U.K. Refineries. Applicants aged 30-45 must have served full apprenticeship and have 1st Class M.O.T. Certificate. Some experience in industry preferable. Non-contributory Pension Scheme.—Write giving full particulars of qualifications and experience quoting H.3747 to BOX 9016, c/o 191, GRESHAM HOUSE, E.C.2. M 72

DEVELOPMENT ENGINEERS AND PHYSICISTS

are required for work in the new and rapidly expanding laboratories of Louis Newmark Ltd., at New Addington, Surrey. The work includes the design and development of instruments and equipment for the aircraft and allied industries, and some working experience of small electromagnetic instruments is desirable. Good salary based on age and experience. Pension Scheme.—Apply in writing giving full particulars to: PERSONNEL OFFICER, LOUIS NEWMARK, LTD., PREFECT WORKS, PURLEY WAY, CROYDON. M 64

DRAUGHTSMEN. Applications are invited from experienced Mechanical Engineering and Design Draughtsmen to be the nucleus of a newly-formed Central Engineering and Planning Department to deal with expansion projects and new development work for the whole of the Pilkington Group of Companies at home and overseas.

Minimum starting salaries for Draughtsmen of H.N.C. standard range between £715 at age 25, to £840 at age 35, plus agreement and staff bonuses for which they become eligible after one year's service. Conditions include contributory Superannuation Fund, assisted house purchase and family education schemes.

Reply, stating age, qualifications and experience, to the GROUP CHIEF ENGINEER, PILKINGTON BROTHERS LIMITED, ST. HELENS, LANCASHIRE. M 68

DRAUGHTSMEN, SENIOR, urgently required by firm of Consulting Engineers. Heavy structural steelwork and platework. High salary and bonus. Comfortable working conditions and subsidised meals. Five-day week. London area.—Write stating age, experience, and salary required to BOX L 963, Offices of ENGINEERING.

BRUSH
ELECTRICAL ENGINEERING
COMPANY, LTD.,
LOUGHBOROUGH, LEICS.

Owing to expansion in the Turbine Division vacancies occur for the following personnel:

DESIGN ENGINEER with experience of mechanical design for interesting design work on radial flow steam turbines.

DESIGN ENGINEER for design work on axial flow turbines. Previous experience of mechanical design and/or operational experience with this type of turbine would be an advantage.

DEVELOPMENT ENGINEERS (two vacancies). Applicants should preferably have had experience of development work and should be capable of handling design, operation and performance analysis. A knowledge of electronic equipment for vibration stress analysis would be an added advantage.

Candidates for all posts must hold an engineering degree, H.N.C. or other equivalent qualifications and should have served an engineering apprenticeship. A good salary will be paid and conditions of service include staff bonus, non-contributory superannuation scheme. There are excellent opportunities for young engineers seeking a progressive appointment with a vigorous and expanding Company. Please reply to the CHIEF PERSONNEL OFFICER. M 77

CIVIL ENGINEERING MANAGER. Leading British Company with international organisation requires services of Qualified Civil Engineer to take control of major projects. The company has headquarters in London and will only consider applications from fully qualified civil engineers holding University degrees in civil engineering or Associate Membership of the Institution of Civil Engineers. The successful applicant will be required to take complete control of large civil engineering projects each representing several million pounds in value. Extensive experience in the organisation, design, and costing of large civil engineering works is essential. The appointment will be based on London headquarters and carry a salary within a scale of £3,000 to £4000, dependent on qualifications and experience. Pension scheme and assistance for house purchase are available. Applications stating age, experience, qualifications and present salary, which will be treated in strictest confidence, should be sent to BOX M 80, Offices of ENGINEERING.

CHIEF ENGINEER. Leading British Company with overseas connections requires a Chief Engineer to supervise the civil, mechanical and electrical constructional work on site of a major engineering project. Applications will be considered only from senior engineers with wide experience of such work. The post is a home appointment and depending upon experience, carries a salary in the range £2500 to £3500. Amenities include a house purchase scheme and pension fund. Applications will be treated as strictly private and confidential and should state age, qualifications, experience and present salary to BOX M 81, Offices of ENGINEERING.

DRAUGHTSMEN, SENIOR AND JUNIOR, preferably with Railway or Automotive experience, required for Diesel Traction Drawing Office situated in London area, N.W.10. Apply in writing giving age, details of experience and salary required, to GENERAL MANAGER, BRITISH UNITED TRACTION LTD., 14, HANOVER SQUARE, LONDON, W.1. M 87

WORKS MANAGER required by Company in the Manchester Area engaged in General and Specialist Engineering including Foundry work. Good salary will be paid to man with ability, personality, drive and initiative.—Please give full details.—BOX M 88, Offices of ENGINEERING.

DESIGN ENGINEERS required by progressive company manufacturing fuel injection and electrical equipment. London area. Monthly staff appointments with appropriate pension and holiday privileges. H.N.C. desirable but not essential. Write full details including age, education, experience, employment history including present employment and salary in strict confidence quoting Ref. E.D. 2 on letter of application to BOX M 76, Offices of ENGINEERING.

BRITISH PETROLEUM COMPANY LIMITED has vacancies for

MECHANICAL ENGINEERS at their ADEN Refinery. Applicants aged 25-35, must possess either National Certificate or Diploma preferably at Higher Level or A.M.I.Mech.E. or 1st or 2nd Class M.O.T. Certificate or B.Sc. Degree. Full engineering apprenticeship essential, except in the case of those holding B.Sc. Degree, followed by three years suitable experience in industry. Attractive salary plus generous allowance in local currency, free passages out and home, free medical attention, good leave arrangements, Pension Scheme, kit allowance and air-conditioned accommodation.—Write, giving full details of qualifications and experience, quoting F.506B, to BOX 1811, c/o 191, GRESHAM HOUSE, E.C.2. M 73

ENGINEER required for Electrical and Mechanical Design and Development Work on Light Electric and Electronic Apparatus. Good degree or equivalent. Must be capable of original thought and be able to lead a small team of specialists. Previous experience not essential if training has been sound and outlook is progressive. Salary up to £1350 per annum, London area. Write full details including age, experience, employment history including present employment and salary quoting Ref.: E.D.1 on letter of application to BOX M 74, Offices of ENGINEERING.

IMPERIAL CHEMICAL INDUSTRIES LIMITED, METALS DIVISION. There is an interesting vacancy in the Ammunition Department at Witton for a

METHODS ENGINEER to assist in the development of improved mass production methods and machines. This position will also include some design work. Applicants, preferably in the age range 28-35, should possess either a degree or Higher National Certificate in Mechanical Engineering. Experience of this type of work is essential. Excellent conditions of employment include generous starting salary, Pension and Profit Sharing Schemes. Applications should be addressed to the STAFF MANAGER, IMPERIAL CHEMICAL INDUSTRIES LIMITED, KYNOCH WORKS, WITTON, BIRMINGHAM 6, quoting AD/2/ENG. M 99

DRAUGHTSMEN. Applications are invited from Senior and Junior Draughtsmen with general experience in Light Electrical or Mechanical Engineering or specialised experience in Small Internal Combustion Engines or Automobile Equipment and accessories. The vacancies are in North London and salary will be commensurate with ability and experience. Please write full details including age, education, experience, employment history, including present employment and salary in strict confidence, quoting Ref. E.D.3 on letter of application to BOX M 75, Offices of ENGINEERING.

ENGINEERS are required by the Group Engineering Division of the REED PAPER GROUP who will be capable after training of carrying through complete engineering projects connected with paper mills from the development to the final construction stage. Paper mill experience an advantage, but candidates must be technically qualified in engineering. Assistance is offered with housing, excellent working conditions and salary, non-contributory pension fund. Applications must be submitted in writing stating age, qualifications and experience to GROUP PERSONNEL OFFICER, ALBERT E. REED & CO. LTD., LARKFIELD, Nr. MAIDSTONE, KENT, quoting reference E.G.E./2. M 90

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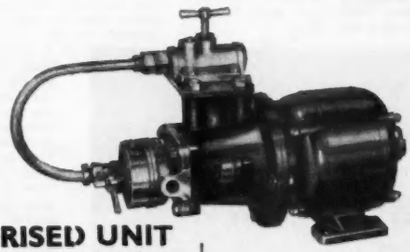

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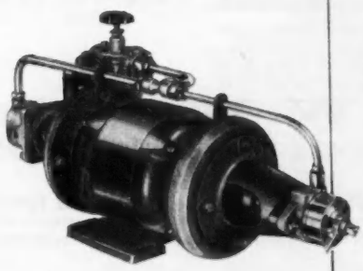

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SOME PROVED APPLICATIONS

Hydraulic feeds in machine tools, textile machinery, drilling equipment, test rigs, etc. Lifting gear in mechanical handling. Hydraulic equipment in aircraft (80,000 supplied to aircraft industry.) Hydraulic pressure in testing machines. Metering and mixing equipment. Pressure lubrication. Oil Burner feed equipment.

Write for further details to:—

Thomas Savery Pumps
LTD.

BRACEBRIDGE ST. BIRMINGHAM, 6. Tel: Aston Cross 1366-7

Do not disturb

Can two hands do the work of four — or six — or more? Does increased production necessarily require more man-power?
Can life be made more attractive and easy for my present operators?
These are questions often asked by harassed production executives in practically every industry, and the lucky ones find the answers they want in Enots several booklets explaining in fullest detail the advantages of controlled air power in the factory.
Automate with Enots and British Bellows Pneumatic Equipment NOW! Our technical representatives are ready to advise you on your particular problems — and without the slightest obligation of course.

Two short films "Production Miracles" and "Operation Push Button" produced by the Bellows Corporation of Akron, Ohio, U.S.A., and illustrating the application of pneumatic devices as aids to increased production and efficiency, are available for exhibition on application to Benton and Stone Limited.

Enots and BRITISH BELLOWS

PNEUMATIC EQUIPMENT

BENTON & STONE LTD., ASTON BROOK ST., BIRMINGHAM 6, ENGLAND
See our exhibits at the INTERNATIONAL MACHINE TOOL EXHIBITION OLYMPIA 22nd June - 6th July on Stand 501, Empire Hall Gallery.

SENIOR AND JUNIOR DESIGNERS for reinforced concrete and/or steelwork required for London Office. Considerable scope for advancement. Junior assisted in study courses involving day attendance. Consideration given to holiday arrangements.—BOX M 42, Offices of ENGINEERING.

PLANT LAYOUT DRAUGHTSMEN required urgently by large Cable Manufacturers, N. London. Applicants must be fit and previous experience in cable factories an advantage. Full apprenticeship and H.N.C. desirable but not essential.—Apply in writing giving full details, past experience, salary required and availability to Chief Works Engineer, BOX L 940, Offices of ENGINEERING.

Required.
EXECUTIVE WITH EXPERIENCE in Export Trade, having knowledge of French and/or Spanish, for development of Sales of Technical and Engineering equipment in General Export Market. Provided gentleman with the right business acumen applies, degree in Engineering is not essential.—Apply BOX 38, c/o YARRELL, 17, RYDER STREET, LONDON, S.W.1. M 21

ESTIMATOR-RATEFIXER: required with workshop experience for the Engineering Department of factory in the Eastern Counties. Apprenticeship and National Certificate standard essential. Please write, giving age, qualifications and particulars of previous experience, to the PERSONNEL MANAGER, BEXFORD, LTD., BRANTHAM, NR. MANNINGTREE, ESSEX, or 'phone the Asst. Engineer at Manningtree 266. M 43

URQUHART LINDSAY & ROBERTSON
ORCHAR LIMITED,
BLACKNESS FOUNDRY,
DUNDEE.

WORKS MANAGER required for above Company which manufactures gearing, general engineering products, textile machinery, medium and heavy machine tools, having proven experience and up to date knowledge of modern shop floor and foundry practice. Capable of directing shop supervision and successfully running a large engineering works with a substantial plant.

Applicants are invited to apply, in strict confidence, and should give details of education, training, experience and positions held. Applications should be marked "Private & Confidential" and addressed to "THE SECRETARY."

The position carries a substantial salary.
L 988

LOCOMOTIVE DRAUGHTSMAN, ALSO WORKS MANAGER, required by British Railway operating Chile and Bolivia. Applications to, and full details from, BOX No. 89, c/o CHARLES BARKER & SONS LTD., 31, BUDGE ROW, LONDON, E.C.4. M 52

GEORGE KENT LIMITED, LUTON, BEDS., have a number of vacancies on their staff for **SKILLED AND EXPERIENCED MEN** in the field of industrial instruments. (Women will be considered for a number of these posts as specified below). These vacancies have been caused solely by the growth of the Company and its long and steady expansion in Great Britain and throughout the world. All posts are permanent and pensionable.

It is the Company's wish to recruit men and women who will, like so many of the present employees, make their career with the firm. Salaries for all posts will, of course, depend upon experience and are progressive with the attainment of skill and service.

All replies, which will be treated in the strictest confidence, must give full details of age, training, experience and present salary, and should be addressed to:—Administrative Manager, George Kent Limited, Luton, Beds.

SALES CONTRACTS ENGINEERS.

Candidates must have a sound basic theoretical training in electrical, mechanical or chemical engineering. Experience in the design or use of industrial instruments and some familiarity with the layout of industrial process plant is desirable. Contracts engineers work at Luton and are responsible for tendering for and engineering a wide range of industrial instrumentation and control. Women graduates in appropriate subjects will be fully considered for this work.

DRAUGHTSMEN.

Vacancies exist in the Drawing Office at Luton for competent draughtsmen who should have experience in George Kent's type of work though training will be given to experienced applicants who are otherwise suitable. Experienced women draughtsmen will also be considered for these posts. Promotion to the position of Sales Contracts Engineer is possible in time for interested draughtsmen of proven ability.

TECHNICAL CLERKS.

The Sales Contracts Office in Luton has vacancies for Technical Clerks. Men or women with experience of technical correspondence in the engineering or chemical industries will be welcomed. Ex-servicemen from the technical arms of the forces could well be suitable for this work depending upon their experience. M 13

Large Civil Engineering Company with Headquarters in the Liverpool area, carrying out railway electrification schemes require to expand their technical and drawing office staffs immediately. Applications are accordingly invited from
DRAUGHTSMEN (Mechanical or Structural)
TECHNICAL ASSISTANTS (Civil or Mechanical), qualified to a minimum of O.N.C. standard for the design, estimating and engineering sections. Excellent rates of remuneration and conditions of service, including a five day week.—BOX M 96, Offices of ENGINEERING.

SALES CORRESPONDENT required for tendering for Electric Resistance and Gas Furnaces and General Correspondence. Good education and Engineering training necessary but knowledge of Furnaces and Heat Treatment not essential although advantageous. Non-contributory pension scheme. Write giving details of training and experience to PERSONNEL MANAGER (JMP) BIRLEC LIMITED, TYBURN ROAD, BIRMINGHAM, 24. M 97

Classified Advertisements continued on Page 150

MECHANICAL-ELECTRICAL ENGINEER for post abroad, aged under 30, free house, good conditions, allowances and superannuation, excellent prospects: University or Technical College qualifications essential and experience in General Workshop practice. Must have good electrical knowledge. Write giving details of education and experience.—WRITE 0853 WM. PORTEOUS & CO., GLASGOW. M 31

PROCESS ENGINEER. PHILBLACK LIMITED Carbon Black Manufacturers, invite applications from Engineers with Graduate or similar qualifications in Chemical or Mechanical Engineering, for a position in their Process Engineering Department at Avonmouth. Candidates should have some experience of Chemical, Petroleum or similar Plant and should be prepared to undertake a variety of duties including Plant investigation, design and commissioning. This position arises from the continued expansion of the Company's activities and will appeal to an able and alert man, keen to progress with a young and growing concern. Minimum salary £900. Contributory Staff Pension Scheme. Full details of career should be addressed to WORKS MANAGER, PHILBLACK LIMITED, AVONMOUTH DOCKS ESTATE, AVONMOUTH. M 30

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PATENTS.

THE PROPRIETOR OF PATENT NO. 689358 for "Flexible Pipe Coupling" desires to secure commercial exploitation by Licence or otherwise in the United Kingdom. Replies to Haseltine Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2. M 65

Notice is hereby given that G. D. Miller seeks leave to amend the Complete Specification of the Application for Letters Patent No. 746,103 for an invention entitled

"IMPROVEMENTS IN OR RELATING TO A LUBRICATOR."

Particulars of the proposed amendments were set forth in the Official Journal (Patents), No. 3513, dated 13th June, 1956.

Any person may give Notice of Opposition to the amendment by leaving Patents Form No. 36 at the PATENT OFFICE, 25, SOUTHAMPTON BUILDINGS, LONDON, W.C.2, on or before (13th July, 1956.

J. L. GIRLING,
Comptroller-General. M 84

THE PROPRIETORS OF PATENT NO 650967 for "IMPROVEMENTS IN OR RELATING TO A STAKING MACHINE" desire to secure commercial exploitation by Licence or otherwise in the United Kingdom.—Replies to Haseltine Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2. L 874

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Operations are carried on in seven workshops, located in Melbourne and Sydney using the most modern equipment.

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7½" AND 8½" CENTRE M.D. MODEL LATHE
Inverted Vee type bed; Timkenised headstock with large hollow spindle; quick change gearbox; multi-position tourway toolpost; Schlesinger limits throughout.
30"/36" SWING BORING & FACING LATHE
Timkenised headstock; spindle speeds 7 to 300 r.p.m. or higher; quick change gearbox; double wall apron; automatic lubrication. Can be supplied with Hexagon Turret in place of Square Toolpost.
PARTING-OFF LATHE
Straight bed lathe with pneumatic or hydraulic chuck equipment, front and rear toolposts, self-contained motor drive, four-speed feed box, electric suds pump, etc. Designed for high output.
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HIGH CLASS MACHINE TOOL MAKERS
Manufacturers of Centre Lathes from 7½in. to 20in. centres, 30in. and 36in. swing Boring and Facing Lathes with square or hexagon turret. Combination Turret Lathes; 19in. stroke shaping machines.
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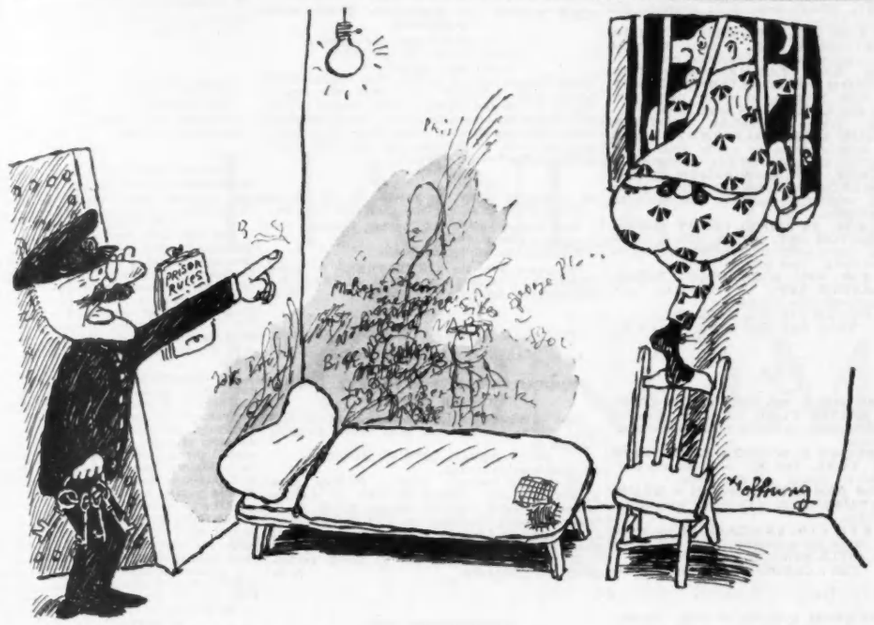

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ONE HEAVY DUTY
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Late type machine, multi-motor drive, two toolboxes on cross-rail, one tool-box on each upright.

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Table Speeds .....7 ft.—42 ft./min.
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Classified Advertisements continued on Page **152**

SOAG

REBUILT AND GUARANTEED HEAVY DUTY SLOTTERS AVAILABLE IMMEDIATELY

★ All late type machines, motorised for 400/3/50 supply.

We shall be pleased to quote against your requirements. Send us details.

BUTLER 8in. High Production, motor drive, with automatic and hand long., cross and rotary table movements, max. length of stroke 8in., table dia. 20in., dia. admitted 24in., ram face to frame 12in., table traverse long. and cross 15½in., 4 ram speeds, 31-90 strokes/min., h.p. of motor 5.

BUTLER 8in. High Production, with tilting body, motor drive, with automatic and hand long., cross and rotary table movements, max. length of stroke 8in., table dia. 20in., dia. admitted 24in., ram face to frame 12in., body tilts back or forward 10 deg., 4 ram speeds, 31-90 strokes/min., h.p. of motor 4.

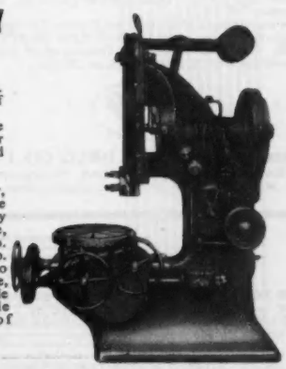
ORMEROD 8in. High Production, motor drive, with automatic and hand long., cross and rotary table movements, max. length of stroke 8in., table diameter 18in., max. diameter admitted 30in., long./cross traverse of table 13½in./15½in., 4 ram speeds, 23-71 strokes/min., h.p. of motor 4.

BUTLER 12in. High Production with tilting body, motor drive, with automatic and hand long., cross and rotary table movements, max. length of stroke 12in., table diameter 30in., max. diameter admitted 42in., long./cross traverse of table 24in./24in., 4 ram speeds, 21-61 strokes/min., h.p. of motor 7½.

BUTLER 28in. High Production, with electric feed unit and power traverse, enabling control of the machine to be made from the operator's push-button station, ram balanced by counterweight, max./min. stroke of ram 28/10in., dia. admitted 5ft. 9in., gap 3ft. 9in., table traverse long. or cross 3ft. 6in., table dia. 5ft., h.p. of main motor 20.

There is a second machine of this size available, but with separate motor for power traverse in place of the electric feed unit.

BUTLER 30in. High Production Slotter, with separate motor drive to ram, table feeds and power traverse, ram balanced by counterweight, multi-tee slotted ram face, length of stroke max./min. 30in./12in., No. of speeds 6, speed cycle from 7 to 24 p. min., ram face to frame 3ft. 9in., ram to table max. distance 5ft. 3in., table traverse, long. (across from centre) 3ft. 6in., table traverse, trans. (in and out) 3ft. 6in., table dia. 5ft., h.p. of main motor 20, h.p. of feed motor 5.



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PENSOTTI 5ft. Motor Driven
High Speed
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with taper turning and screw cutting attachment. Max. swing 62 in. dia. Rapid power traverses. 16 speeds from 4 to 145 r.p.m. Motor 28 h.p. Approx. weight 10 tons. 1951-2 machines in excellent condition.

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3 CWT. MASSEY GUIDED TYPE PNEUMATIC FORGING HAMMER, with electrical equipment.

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UNUSED MOTOR DRIVEN PLANISHING HAMMER, by Oliver, 550 blows per minute.

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TAYLOR 7 IN. BALL BEARING SPINNING LATHE. Motorised 400-440/3/50. Height of centres, 7 in. Length of bed 48 in.

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BESCO UNIVERSAL SWING BEAM FOLDING, BENDING AND BOX FORMING MACHINE. Capacity 49 in. by 14 s.w.g. Min. trunk formed round the beam 6⅞ in. by 7½ in. high.

TWO RATZER NO. 19 SIZE INCLINABLE PRESSES. Motorised 415/3/50. Pressure approx. 12 tons. Stroke 1½ in. Centre to back 5 in. Weight about 14 cwts.
Photographs of the above are available.
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Of Every Description. Attractive Prices.

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One secondhand 14 in. by 0-4-0 Saddle Tank Locomotive, in good working order, by ANDREW BARCLAY, 1947. Standard rail gauge, copper firebox and tubes. Tractive effort 14,300 lb., Boiler pressure 160 p.s.i.
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B.C.S.

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ONE 600 K.W. SULZER DIESEL GENERATING SET, 220-440 volts, D.C., complete with Auxiliaries, Spares, etc.
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TWO 20 K.W. HILL & CO./DELCO DIESEL GENERATING SETS, 120 volt D.C., 1,450 r.p.m., complete with Auxiliaries.
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22,000 BABCOCK & WILCOX C.T.M. STEEL CASED WATER TUBE, 260 lb. with Superheater, Economiser by Green, Chaingrate Stoker. All mountings.
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EDWARD RUSHTON SON & KENYON are instructed by the Vendors to
SELL BY AUCTION piecemeal, on the above premises at Victoria Street, Nelson, at 11 a.m., prompt on WEDNESDAY AND THURSDAY, JUNE 27th AND 28th, the

MODERN MOTORISED MACHINE TOOLS
and
ENGINEERING EQUIPMENT,

including Ward No. 3A, 2 Ward No. 2A, Ward No. OE and 2 Ward No. 3 Capstan Lathes, 2 Lang 6½ in. centre lathes, Morris 9 in. lathe, 2 Berry 6 in. lathes, 4 Atlas 5 in. lathes, Butler 18 in. super shaper, J. & S. univ. cutter and tool grinder and equipment, Archdale 30 in. vert. boring and milling m/c, B. & S. univ. horiz. miller, Ajax bench miller, 2 Archdale vert. drills, Churchill 12 in. ring and surface grinder model RA, Churchill surface grinder, Landis cylindrical grinder, Fel crack detector, Delapena honing m/c, Ajax and Tauco bench drills, 6 Manchester hacksaws, motorised compressor, 2 in. hydraulic bender, sandblasting plant, demagnetiser, profile cutter, G.E.C. 40 KVA welding plant, Quasi Arc welding generator for stainless steel, 3 ft. guillotine, bending rolls, bench folding m/c, 7 tons new steel bar, P.C.I. surface table 5 ft. by 3 ft., rotary table, furnace, flex. shaft grinder, Hardometer, Matrix slip gauges, large quantity of equipment including thread and caliper gauges, micrometers, roller boxes, dieheads, capstan eq., twist drills, milling cutters, dies, heavy gauge steel racks and chests of drawers, Kardex cabinets, steel desks and office equipment.
ON VIEW: June 20th, 21st, 22nd, 23rd, 25th and 26th from 9 a.m. to 5 p.m. (noon on Saturday) and on mornings of Sale.
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By Order of the Secretary of State for Air.
LORDS BRIDGE, CAMBS.
(Cambridge 5 miles).
Highly important Sale of
130 BUILDINGS
being mainly Timber, Nissen, Laing, Steel and Asbestos Frame Huts of varying sizes.
165 TONS OF STEEL STANCHIONS AND GANTRYS,
being mainly 6 in. by 5 in. H Steel uprights in 16 ft. lengths, overhead gantrys being 8 in. by 4 in.
1,930 YARDS OF RAILWAY LINE AND SLEEPERS,
together with the many and varied
MISCELLANEOUS EFFECTS
comprising especially :—
Water Pumps, electric motors, high volume water storage tanks, telegraph poles, power cable, central heating boilers and calorifiers, large number of 8 ft. angle iron posts, ammunition boxes, fire extinguishers, concrete slabs and blocks; sewage filter-bed-sprinkler, cast-iron pipes, air filtration and vent equipment; metal window frames, doors, etc.
which
GRAIN & CHALK
are instructed to sell by auction on the site on WEDNESDAY, JUNE 20th, 1956, AT 11 a.m.
View days: Monday and Tuesday, 18th and 19th June and morning of sale.
Refreshments will be obtainable.
Catalogues from the AUCTIONEERS, 8, ROSE CRESCENT (Tel. 58331-3), AND 11, ALEXANDRA STREET (Tel. 4696), CAMBRIDGE. M 27

THURSDAY NEXT, JUNE 21st, at 3.30 p.m.
STANDON, HERTFORDSHIRE,
Modern single storey
AGRICULTURAL MACHINERY AND REPAIR DEPOT.
Close to railway station, in main road, A.120 with large volume of traffic to East Coast, Planning consent for
FOUR RETAIL PETROL PUMPS
and double access to road.
450 ft. road frontage. 5,500 sq. ft. floor space. Approx. 3 acres. Freehold for Sale by Auction (unless previously sold) at George Hotel, North Street, Bishop's Stortford, on THURSDAY, 21st JUNE, 1956, at 3.30 p.m. Printed Particulars and plans from MESSRS. GRAIN & CHALK, 11, ALEXANDRA STREET, and 8, ROSE CRESCENT, CAMBRIDGE. M 28

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LEWES, SUSSEX.

EXCELLENT DOUBLE FRONTED SHOWROOM 35ft. frontage, Offices, Workshops, etc., main trading position, having an area of over 8,500 sq. ft. Good vehicle access at rear. Vacant possession. Price £15,500 freehold. Apply PETER R. JENSEN, F.A.L.P.A., 165, HIGH STREET, LEWES. Tel.: 1881/2. M 12

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NON-FERROUS FOUNDRY near London, equipped for sand and die casting, machining. At present employing 30 people. Room for expansion. To let as going concern.—BOX M 39, Offices of ENGINEERING.

FOR HIRE.

LATTICE STEEL ERECTION MASTS (light and heavy) 30 ft. to 150 ft. high, for immediate hire. —BELLMAN'S, 21, Hobart House, Grosvenor Place, S.W.1. G 72

IT'S A GOOD POINT TO REMEMBER

WARDS might have it!

THOS. W. WARD LTD.
ALBION WORKS, SHEFFIELD
G 556

COMPANY MEETING.

RANSOMES SIMS AND JEFFERIES.

CAPITALISATION OF RESERVES.

The 72nd annual general meeting of Ransomes Sims & Jefferies, Ltd., was held on June 4 at Ipswich, Sir Reuben Hunt, chairman, presiding.

The following is an extract from his circulated statement :

The trading results of the Parent Company and its Subsidiaries for the year to 31st December, 1955, amount to £418,202 made up and compared with 1954 as follows:

	1955	1954 (adjusted)
	£	£
Parent Company ...	397,588	353,871
Ransomes Watford ...	8,466	10,305
Steel Case Company *Loss*	1,338	2,708
Ransomes South Africa ...	13,486	14,071
Ransomes Australia ...	*Not yet operating*	
	£418,202	£375,539

There has been a further increase in home trade despatches and some increase in exports, but licensing, overseas manufacture and price competition from other countries are ever-present problems.

CAPITAL STRUCTURE

You will note from the Directors' Report that Resolutions will be put forward at the Annual Meeting proposing an increase in the authorised Ordinary capital by £1,950,000 and the conversion of 50,000 Unissued Preference Shares to Ordinary Shares, making a total increase in the authorised Ordinary capital of £2,000,000 of which £500,000 will be issued by way of capitalisation of reserves as explained in the next paragraph, and the balance of £1,500,000 will be available for issue when occasion arises.

The Company's business has expanded in recent years, with the result that the issued equity capital has become disproportionately small in relation to the value of the assets and the working capital permanently employed. We recommend that the disparity of issued equity capital in comparison with capital permanently employed be reduced and we have obtained Treasury consent to the capitalisation of £500,000 of reserves by the application of that sum in paying up 500,000 Ordinary Shares of £1 each for issue fully paid to Ordinary Stockholders on the Company's Register at the close of business on 18th May, 1956, in the proportion of one Ordinary Share for every £4 nominal amount of Ordinary Stock held at such time.

It is recommended that £307,500 standing to the credit of Share Premium Reserve and £192,500 of the Plant Replacement Reserve should be appropriated for the purpose of the proposed capitalisation.

DIVIDEND PROSPECTS

The shares which it is now proposed to issue will rank for payment in full of any dividend declared after the issue in respect of the current and subsequent financial years of the Company and *pari passu* in all other respects with the Ordinary Stock already issued. While trading conditions are admittedly more difficult, the Directors hope to recommend the maintenance of the Ordinary Dividend at 7½ per cent on the capital as increased for the year ending 31st December, 1956, provided there is no further trade set-back.

Fully Paid Renounceable Letters of Allotment will be issued to Ordinary Stockholders entitled as soon as the necessary formalities have been completed. There will be cases in which the proposed distribution could result in the issue of fractions of shares, and the Directors will arrange for the shares divisible into fractions to be sold on the Stock Exchange, and the proceeds divided amongst Ordinary Stockholders who would otherwise have been entitled to the fractions.

PRODUCTION ADMINISTRATION : With the help of Consultants a complete overhaul is being made of our production, stock control and buying procedures. A great deal of attention is also being devoted to simplification of designs and varieties to achieve more economical line production.

MANUFACTURING OVERSEAS : During the year Ransomes Sims & Jefferies (Australia) Pty. Limited has been formed. Our friends, Ruston & Hornsby (Australia) Pty. Limited, have agreed to act as Secretaries and Treasurers for this new Ransome Company. A site has been acquired from Rustons adjacent to their Melbourne property and plans have been approved for the erection of a factory thereon which will assemble and manufacture certain of our products.

A manufacturing agreement is being arranged for certain of our implements with Reid & Gray, Limited, Dunedin, New Zealand. In the near future we shall be forming a Ransome Subsidiary Company in New Zealand.

GENERAL OUTLOOK

We are feeling some anxiety in connection with the maintenance of our export trade, as competition has become very much keener and our prices have risen to an extent which makes it very difficult to obtain orders in some of our export markets.

In the home market, prices have also risen, and there is a tendency on the part of our farmer customers to "make do and mend" rather than buy new equipment.

It is the duty of us all to see that until productivity is still further increased and prices can be stabilised or reduced, any further demands made on the existing resources of the Company are examined with great care.

CHAIRMAN'S ADDITIONAL REMARKS.

The chairman, addressing the meeting, said: You will be interested to hear what has happened since the beginning of the financial year. The value of our incoming order book has decreased by 25 per cent. and this makes the position in our factories both difficult and uncertain. We did not expect this deterioration in trade to take place so rapidly and it has undoubtedly been speeded up by increased prices following repeated wage advances which affect not only our internal cost of production but also all the raw materials we buy from others.

As far as the farmers are concerned, they are reluctant to cover their requirements, although we can see no possibility of reduced prices—rather the reverse if costs continue to rise.

We cannot foresee how long this setback will last, as it appears to be general not only in this country but also in North America, where the bulk of agricultural machinery is made. We are completing the essential part of our plans and should be in an excellent position to take advantage of any improvement in trade, which we hope will take place in the autumn.

The report was adopted and the Board's capital proposals were approved. L 866

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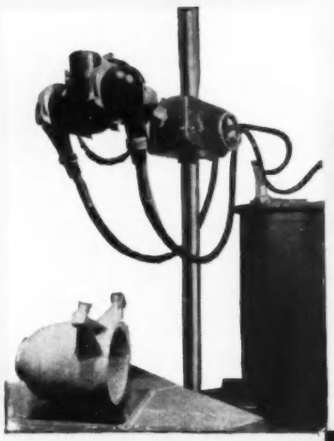

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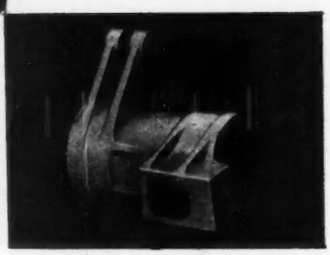

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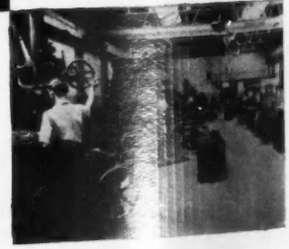

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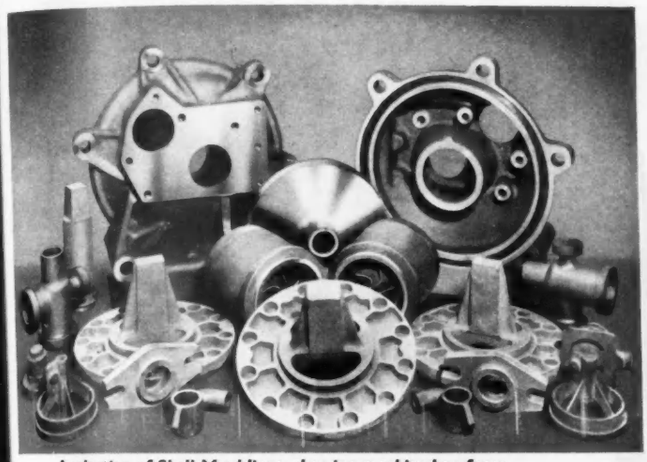

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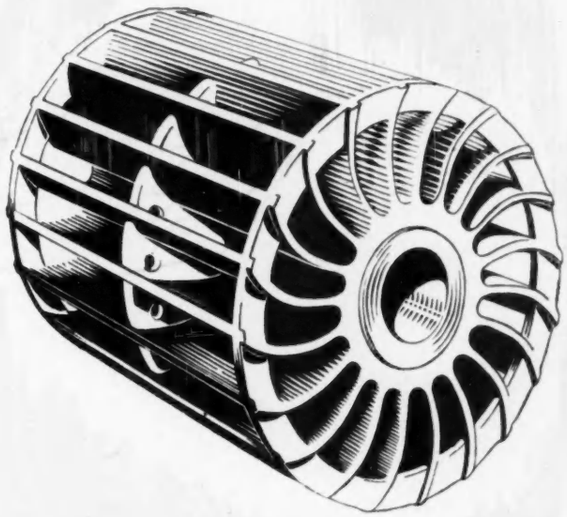

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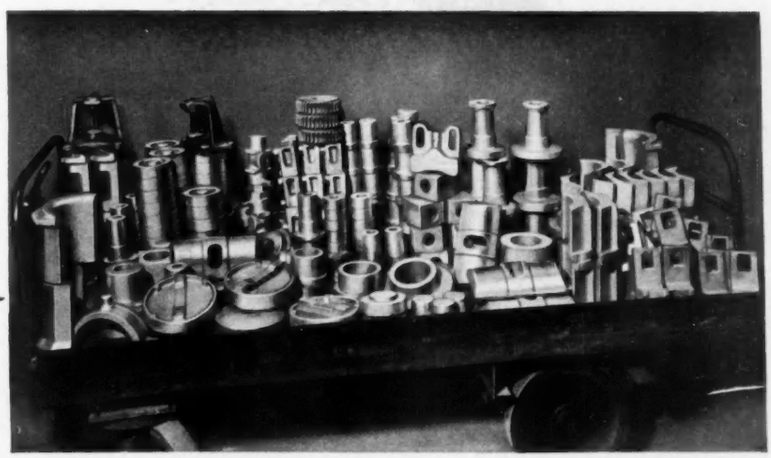

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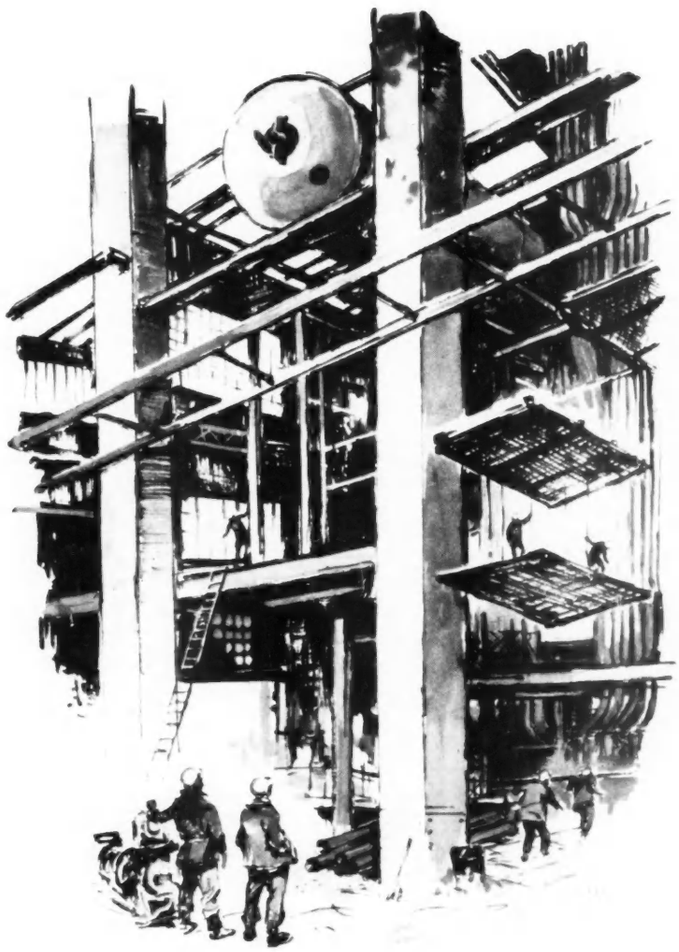

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